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ABSTRACT

This curriculum guide is intended to assist vocational instructors in preparing students for entry-level employment as machinists and preparing them for advanced training in the workplace. The package contains an overview of new and emerging technologies likely to affect machinists, a competency/skill and task list, an instructor's guide, and an annotated bibliography. The following competencies are covered: mathematical calculations necessary to complete machine work; techniques for designing and planning machine work according to instructions, drawings, and handbook references; techniques of precision measurement using a variety of tools; bench work needed in the machine shop; procedures for operating drill presses, grinders, saws, lathes, and milling machines according to established standards; and techniques for performing heat treatment tasks to satisfy job specifications. The instructor's guide consists of a series of task sheets, each of which includes some or all of the following: competency/skill statement; task statement; performance objectives (including conditions in which the task is to be performed, evaluation criteria, and an evaluation standard); suggested student learning experiences; recommended instructional techniques; instructional equipment, materials, and supplies needed to complete the lesson; and recommended resources. (MN)

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MACHINIST

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Machinist

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Arizona Center For Vocational Education
Center For Excellence In Education
Northern Arizona University
September, 1987

FOREWORD

The Machinist Curriculum Guide has been designed to assist instructors in preparing students for entry-level employment and readying them for success in the workplace in advanced training.

The guides are based on the Arizona Validated Competencies and Tasks for Machinists. A committee of Community College and High School Instructors and industry representatives reviewed and revised the competencies from both the community college and high school levels. This new list is now articulated to represent the total Machinist program. Every effort has been made to ensure a curriculum guide which is comprehensively structured to relate to the successful performance of these job skills in the workplace.

This curriculum is part of a three-year plan. This first year the Competency/Skill, Task, Performance Objective, Student Learning Experiences and Resources have been developed and reviewed by industry. Suggested Instructional Techniques and Instructional Equipment, Materials and Supplies Will be incorporated into the existing materials, along with the development of student modules for second year development. the final year has been set aside for field testing the total curriculum package.

ACKNOWLEDGEMENTS

Appreciation is expressed to many individuals for contributing their talent, knowledge, advice and time in developing the Machinist Curriculum Guide.

Curriculum Guides were gathered from many states and these were reviewed by Harry Krueger, a Machine Shop Instructor at Metro Tech. Michael Osbon, a Machine Shop Instructor at Deer Valley Voc-Tech High School wrote the curriculum guide and he also incorporated materials from other states.

Articulation and review of the competencies was performed by an Advisory Committee.

Don Benford
Retired Machinist Teacher

Harry Krueger
Metro Tech

Loyd Myers
Deer Valley High School

An industry committee reviewed the Competency/Skill and Task List and their assistance is greatly appreciated.

Dave Godlove
Carl Talbert
Gilbert Engineering

Gene Riffle
Powill Manufacturing

Larry Hall
Aircraft Gear Corporation

A section titled NEW AND EMERGING TECHNOLOGIES FOR MACHINISTS has been written by Rex Newman from Aircraft Gear Corporation.

The assistance and leadership provided by Nancy F. Dillon and Dr. Jerry R. Cox, Curriculum Unit of the Arizona Center for Vocational Education; has been instrumental in assuring the instructional quality and format consistency of the guide. Dave Muehlbauer, Curriculum Coordinator for the Arizona Department of Education, assisted with the over-all guide development and served as a liaison with the Arizona Center for Vocational Education Curriculum Unit.

Bev Burns, Equity Specialist with New Frontiers, reviewed the curriculum and checked for equity. Special thanks go to Candice Dull and Carla Gahm for word processing this curriculum, and to Barbara Watson for her expertise in solving computer program problems and providing the final data entry before printing.

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New And Emerging Technologies
Machinist

Technology that we are using today is being modified so rapidly that if we do not continually update our procedures and thoughts, we are outdated in a very short period of time.

New techniques in our machining industry, in use today, are not common to the education profession. Industry is constantly gathering their information from attending technical shows, reading periodicals, and talking with manufacturers. New techniques in the various applications of laser measurement, cutting, welding and heat treatment along with the many facets of application of numerical control and computer numerical control are a few of the new techniques being put into use in the industry almost daily.

The changes are so rapid that the new, high-tech, application of machining today, is obsolete tomorrow!

Rex Newman
Aircraft Gear Corporation

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Competency/Skill And Task List - Machinist

1.0 PERFORMS MATHEMATICAL CALCULATIONS NECESSARY TO COMPLETE MACHINE WORK.
1.1 Converts common fractions to decimal fractions
1.2 Converts dimensions to metric size
1.3 Calculates amount of stock required in machine work.
1.4 Calculate feeds and speeds.
1.5 Calculates tapers for machine set-up.
1.6 Calculates tap drill size with formula.
1.7 Calculates tolerances or allowances.
1.8 Calculates depth and widths of slots and grooves on special set-ups.
1.9 Calculates for angular and simple indexing.
1.10 Calculates conversions of revolutions per minute of grinding wheel to surface feet per minute (SFPM).
1.11 Calculates sine-bar dimensions for machine set-up.
1.12 Calculates gear blank specifications.

2.0 DESIGNS AND PLANS MACHINE WORK ACCORDING TO INSTRUCTIONS, DRAWINGS AND HANDBOOK REFERENCES
2.1 Identifies appropriate drafting symbols.
2.2 Follows written or verbal instructions and footnotes.
2.3 Interprets and works from multi-view drawings.
2.4 Interprets size and location dimensions.
2.5 Works from sketches.
2.6 Uses machinists handbook as reference.
2.7 Visualizes parts from drawings.
2.8 Makes sketches of work to be machined.
2.9 Calculates missing dimensions.
2.10 Applies company standards.

3.0 PERFORMS PRECISION MEASUREMENT ACCURATELY USING A VARIETY OF TOOLS
3.1 Measures work with a tape measure.
3.2 Measures work with a 6" pocket rule.
3.3 Layouts work with combination square.
3.4 Cares for precision instruments.
3.5 Measures work with slide caliper rule.
3.6 Measures work with dial calipers.
3.7 Measures work with outside micrometer.
3.8 Measures work with depth micrometer.
3.9 Measures work with depth gauges.
3.10 Measures inside and outside diameters with vernier calipers.
3.11 Measures work with plug and ring gages.
3.12 Measures work with telescope and hole gages.
3.13 Measures work with inside micrometer.
3.14 Measures work on surface plate.
3.15 Measures work with height gages.
3.16 Measures work with gage blocks.
3.17 Measures work with indicators and attachments.
3.18 Measures work with thread wire.
3.19 Measures work with pitch micrometer.
3.20 Layouts work on surface plate.
3.21 Layouts work with hermaphrodite calipers.
3.22 Checks work with sine bar.
3.23 Checks work with surface gages.

3.24 Checks work with radius gauges.
3.25 Measures work with spring calipers.
3.26 Checks work with optical comparator.

4.0 PERFORMS BENCH WORK NEEDED IN MACHINE WORK FIELD
4.1 Inspects work area for safe working environment.
4.2 Cares for hand tools.
4.3 Cuts material with hand hacksaw.
4.4 Bench files workpiece.
4.5 Marks locations with prick punch and center punch.
4.6 Locates holes with transfer screws and transfer punches.
4.7 Drills holes with portable drill.
4.8 Reams holes with hand reamer.
4.9 Cuts threads with hand tap.
4.10 Cuts threads with die.
4.11 Broachs workpiece with a broaching tool.
4.12 Grinds part with hand grinder.
4.13 Assembles or disassembles work with arbor press.
4.14 Straightens workpiece on arbor press.
4.15 Works and shapes metal with hand-held tools.
4.16 Removes and installs dowel pins.
4.17 Removes broken drills and taps.
4.18 Removes damaged screws.
4.19 Removes frozen or seized parts.
4.20 Installs a helical coil wire insert.
4.21 Tests work piece for hardness without hardness tester.
4.22 Tests work piece for hardness with hardness tester.
4.23 Polishes metal.
4.24 Laps surface.
4.25 Hones work piece.

5.0 OPERATES DRILL PRESSES ACCORDING TO ESTABLISHED PATTERNS
5.1 Inspects and changes drive pulley and belt.
5.2 Sharpens drill free hand.
5.3 Sharpens drill with grinding attachment.
5.4 Cleans and lubricates drill press.
5.5 Sets up workpiece.
5.6 Drills hole to size.
5.7 Reams hole to size.
5.8 Countersinks hole to specifications.
5.9 Counterbores hole to specifications.
5.10 Taps hole by hand on drill press.
5.11 Drills workpiece with drill jig.
5.12 Mounts work on V-block.
5.13 Drills hole with automatic feed.
5.14 Taps hole with tapping attachment.
5.15 Laps hole to size.
5.16 Spotfaces to specified dimension.

6.0 OPERATES GRINDERS ACCORDING TO ESTABLISHED STANDARDS.
6.1 Cleans and lubricates grinders.
6.2 Selects and mounts grinding wheels.
6.3 Inspects grinding wheels.
6.4 Balances grinding wheels.
6.5 Dresses and trues grinding wheels on pedestal grinder.
6.6 Dresses and trues machine tool grinding wheel.
6.7 Grinds and shapes chisel and hand tools on pedestal grinder.

6.8 Grinds and sharpens lathe tools free hand.
6.9 Grinds workpiece on magnetic chuck.
6.10 Grinds workpiece squares on surface grinder.
6.11 Grinds workpiece lined up with indicator.
6.12 Polishes with buffing wheel on grinder.
6.13 Grinds angular surfaces.
6.14 Grinds radii and angles on surface grinder.
6.15 Cuts off or parts material with grinding wheel.
6.16 Grinds workpiece between centers.
6.17 Uses a pedestal grinder.

7.0 OPERATES POWER SAWS ACCORDING TO ESTABLISHED STANDARDS
7.1 Cleans and lubricates power saw.
7.2 Replaces saw blade.
7.3 Selects and sets speed and feed for sawing operations.
7.4 Cuts material to length with hack saw.
7.5 Saws along a scribed line.
7.6 Cuts and welds band saw blade.
7.7 Saws internal contours with band saw.

8.0 OPERATES LATHES ACCORDING TO ESTABLISHED STANDARDS
8.1 Cleans and lubricates lathes.
8.2 Faces workpiece.
8.3 Sets lathe speed and rough cuts workpiece.
8.4 Sets lathe speed and finish cuts workpiece.
8.5 Drills holes with lathe.
8.6 Reams holes with lathe.
8.7 Bores holes with lathe.
8.8 Counterbores holes using lathe.
8.9 Countersinks holes using lathe.
8.10 Aligns lathe centers using accurate measurement techniques.
8.11 Turns workpiece between centers on a lathe.
8.12 Knurls parts with lathe.
8.13 Taps holes with lathe.
8.14 Aligns workpiece in four jaw chuck.
8.15 Cuts external tapers with compound rest.
8.16 Cuts tapers by offset tailstock.
8.17 Cuts a long external tapered surface with taper attachment.
8.18 Cuts internal tapered surfaces with taper attachment.
8.19 Die cuts threads with lathe, hand threading.
8.20 Die cuts threads with lathe using die heads.
8.21 Turns or threads long workpiece using follower and steady rest.
8.22 Machines part with carbide tools.
8.23 Swings convex or concave radii from compound swivel.
8.24 Chases single point external threads with lathe.
8.25 Chases single point internal threads with lathe.
8.26 Rechases threads on lathe.
8.27 Chases metric threads.
8.28 Performs lathe filing.
8.29 Polishes workpiece on lathe.
8.30 Cuts acme threads.
8.31 Cuts multiple threads.
8.32 Aligns workpiece on face plate.
8.33 Makes contour cuts with lathe.
8.34 Cuts off workpiece with a parting tool.

9.0 OPERATES MILLING MACHINES ACCORDING TO ESTABLISHED STANDARDS
9.1 Cleans, lubricates and adjusts milling machine.
9.2 Aligns mill head to table.
9.3 Squares workpiece using table vise.
9.4 Aligns milling machine attachments.
9.5 Aligns milling machine fixtures with indicator.
9.6 Aligns machine workpiece mounted on machine table.
9.7 Mills work with end mill.
9.8 Locates work with center finder.
9.9 Locates work with edge finder.
9.10 Drills holes with milling machine.
9.11 Reams holes on mill.
9.12 Mills work with carbide cutters.
9.13 Bores holes to tolerance with milling machine.
9.14 Mills workpiece using indexing operation.
9.15 Mills an angular surface.
9.16 Machines external straight keyway with mill.
9.17 Machines work mounted on V-blocks.
9.18 Machines woodruff keyway.
9.19 Machines work with vertical attachment.
9.20 Flycuts flat surface on mill.
9.21 Jig bores on a milling machine.
9.22 Mills cylindrical work with rotary table.
9.23 Mills an external radius with rotary table.
9.24 Cuts off work on mill.
9.25 Forms mill worksheet.
9.26 Flycuts formed shape on mill.
9.27 Taps hole with mill.
9.28 Sets speed and feed.
9.29 Machines internal slots using slotter.
9.30 Machines work by straddle milling.
9.31 Mills gears to specifications.

10.0 PERFORMS HEAT TREATMENT TASKS TO SATISFY JOB SPECIFICATIONS
10.1 Hardens workpiece.
10.2 Anneals workpiece.
10.3 Stresses draw workpiece.

1.0 **COMPETENCY/SKILL:** Performs mathematical calculations necessary to complete machine work.

1.1 **TASK:** Converts common fractions to decimal fractions.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a blueprint and Machinery's handbook,

EVALUATION: converts common fractions to decimal fractions.

STANDARD: Use formula to convert, and the converted fractions will meet print specifications.

STUDENT LEARNING EXPERIENCES:

1. Note fractional part of dimensions.
2. Divide numerator by the denominator.
3. Round answer off to nearest .0005.
4. Verify answer by placing number over 1000 and reduce.
5. Check answer by looking up conversion chart in Machinery's Handbook.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 2405, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 20-21, 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, Ca., pp. 75-76, 1982.

1.0 **COMPETENCY/SKILL:** Performs mathematical calculations necessary to complete machine work.

1.2 **TASK:** Converts dimensions to metric size.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a blueprint, and conversion chart,

EVALUATION: converts dimensions to metric size.

STANDARD: Change decimal and fractional dimensions to the metric equivalent.

STUDENT LEARNING EXPERIENCES:

1. Study print and locate all dimensions in inches.
2. Select reference material that has metric conversion chart.
3. Replace inch dimensions with metric.
4. Check work for missed dimensions.
5. Accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 394, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 641, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 601-602, 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 76-78, 1982.

1.0 **COMPETENCY/SKILL:** Performs mathematical calculations necessary to complete machine work.

1.3 **TASK:** Calculates amount of stock required in machine work.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a caliper, steel tape, steel rule, blueprint, and inventory of stock,

EVALUATION: calculates amount of stock required in machine work.

STANDARD: Maintain maximum use of scrap stock. Bill of Material is filled in for specific job, stock meets blueprint requirements.

STUDENT LEARNING EXPERIENCES:

1. Study blueprint, check for stock size and material needed.
2. Check scrap stock and select material available.
3. Complete Bill of Materials.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Feirer, John L. GENERAL METALS. 5th Edition. McGraw-Hill Book Company, Novato, CA., pp. 43, 416-417, 1981.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 69-73, 1982.

1.0 **COMPETENCY/SKILL:** Performs mathematical calculations necessary to complete machine work.

1.4 **TASK:** Calculates feeds and speeds.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a milling cutter, calipers, milling machine, workpiece, machinist's handbook, and blueprint,

EVALUATION: calculates feed and speed.

STANDARD: Use formula, select speed and feed for material to be determined by print.

STUDENT LEARNING EXPERIENCES:

1. Review blueprint and measure workpiece.

2. Determine machining specifications.
   a. Amount of stock to remove
   b. Number of cuts needed
   c. Finish required
   d. Workpiece material and size
   e. Cutter material and size

3. Calculate speed of machine using the formula.
   $CS = \frac{\pi \times DN}{12}$
   D= diameter of cutter in inches
   N= RPM

4. Calculate feed of machine using the formula.
   F = R x T x RPM
   F= feed rate in inches per minute
   R= feed per revolutions of tooth per revolutions
   T= number of teeth

5. Verify calculations and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division. McGraw-Hill Book Company, Novato, CA., pp. 269-272, 1983.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 1757-1796, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 278, 307-313, 1984.

1.0 **COMPETENCY/SKILL:** Performs mathematical calculations necessary to complete machine work.

1.5 **TASK:** Calculates tapers for machine set-up.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a workpiece, machinist's handbook, and blueprint,

EVALUATION: calculates tapers for machine set-up.

STANDARD: Use formula to calculate taper, and to offset tailstock.

STUDENT LEARNING EXPERIENCES:

1. Review blueprint and determine dimensions for taper.

2. Calculate taper per inch using the formula.

   a. Small diameter, large diameter, and length given, use formula:

$$T = \frac{(D-d)}{L}$$

   T = taper per inch
   D = large diameter in inches
   d = small diameter in inches
   L = length of taper in inches

   b. To obtain taper per foot multiply (T) by 12
   c. Overall length is longer than taper formula is

$$tpf = \frac{\text{large diameter-small diameter} \times 12}{\text{length of taper (in.)}}$$

   d. To calculate tailstock offset formula ia

$$\text{Offset} = \frac{tpf \times \text{total length (in.)}}{24}$$

3. Check calculations with Machinery's Handbook and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division. McGraw-Hill Book Company, Novato, CA., pp. 210-216, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division. McGraw-Hill Book Company, Novato, CA., pp. 264-265, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 250-255, 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 445-446, 1982.

1.0 **COMPETENCY/SKILL:** Performs mathematical calculations necessary to complete machine work.

1.6 **TASK:** Calculates tap drill size.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a workpiece, reference material, and blueprint,

EVALUATION: calculates tap drill size.

STANDARD: Use formula, select drill; letter, fraction, or decimal, drill meets tap specifications for threads (coarse/fine).

STUDENT LEARNING EXPERIENCES:

1. Inspect print for threaded hole size.
2. Calculate tap drill size using formula:
   $$T.D.S. = D - \frac{1}{N}$$
   D = major diameter of tap
   N = number of threads per inch
3. Select tap drill checking decimal equivalents for letter, fraction, or decimal drill.
4. Accept or reject calculations.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division. McGraw-Hill Book Company, Novato, CA., pp. 76-77, 1983.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 1403-1409, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 112-113, 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 154, 1982.

1.0 **COMPETENCY/SKILL:** Performs mathematical calculations necessary to complete machine work.

1.7 **TASK:** Calculates tolerances or allowances.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a workpiece, Machinery's Handbook, and blueprint,

EVALUATION: calculates tolerances or allowances.

STANDARD: Use formula to calculate maximum and minimum tolerances, select reference material to obtain allowable tolerances.

STUDENT LEARNING EXPERIENCES:

1. Check blueprint, note fit required, tolerances of mating part, tolerances for desired fit in handbook.

2. Calculate bilaterial tolerances with formula:
   a. Maximum size of mating part plus maximum tolerance of mating part, equals upper limit of dimension

   b. Minimum size of mating part minus minimum tolerances of mating part, equals lower limit of tolerances

   c. Upper limit minus lower limit = total allowance

   d. $\frac{\text{Total allowance of workpiece} - \text{bilateral tolerance}}{2}$

3. Accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division. McGraw-Hill Book Company, Novato, CA., pp. 91-92, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division. McGraw-Hill Book Company, Novato, CA., pp. 75, 1984.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 1517-1566, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 22-24, 1984.

1.0 **COMPETENCY/SKILL:** Performs mathematical calculations necessary to complete machine work.

1.8 **TASK:** Calculates depths and widths of slots and grooves on special set-ups.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a micrometer, caliper, depth micrometer, workpiece, references, and blueprint,

EVALUATION: calculates depths and widths of slots and grooves on special set-up.

STANDARD: Select formula used (if needed) from handbook, check calculations of depth, width, and length to meet print specifications.

STUDENT LEARNING EXPERIENCES:

1. Review print and determine dimensions needed for machining workpiece.
2. Check Machinery's Handbook for table or formula.
3. Calculate required dimensions and round off answer.
4. Check answer by repeating steps 2-3.
5. Accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division. McGraw-Hill Book Company, Novato, CA., pp. 406-408, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 318-321, 1984.

1.0 **COMPETENCY/SKILL:** Performs mathematical calculations necessary to complete machine work.

1.9 **TASK:** Calculates for angular and simple indexing.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a workpiece, reference material, indexing head, index plates, machinist's handbook, and blueprint,

EVALUATION: calculates for angular and simple indexing.

STANDARD: Use formula to obtain indexing movement, and to obtain angular indexing. Indexing and angular answers meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Review blueprint and select indexing head and plates.
2. Calculate simple indexing with formula:

$$\frac{40}{\text{No. of divisions}} = \text{no. of turns}$$

3. Use table to check calculations.
4. Calculate angular indexing dimension: Change degrees to minutes with the formula.

$$\frac{\text{Minutes required}}{540}$$

   a. One full turn on indes head equals 9 degrees
   b. Calculate number of full turns for each 9 degrees required
   c. Select index plates

5. Check calculations with tables in machinist's handbook.
6. Accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division. McGraw-Hill Book Company, Novato, Ca., pp. 278-279, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division. McGraw-Hill Book Company, Novato, CA., pp. 358-359, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 324-326, 1984.

1.0 **COMPETENCY/SKILL:** Performs mathematical calculations necessary to complete machine work.

1.10 **TASK:** Calculates conversions of revolutions per minute of grinding wheel to surface feet per minute (SFPM).

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a Machinery's Handbook, grinding wheel specifications, grinding machine specifications, and reference material,

EVALUATION: calculates conversions of revolutions per minute of grinding wheel to surface feet per minute (SFPM).

STANDARD: Use formula for conversion, maximum speed of wheel not to exceed handbook specifications, grinding wheel checked for cracks, diameter, and maximum speed.

STUDENT LEARNING EXPERIENCES:

1. Check grinding wheel diameter.
2. Check grinding wheel for maximum speed noted.
3. Check speed of grinder.
4. Calculate surface feet per minute with the formula:

   $$sfpm = rpm \times \frac{D}{12} \times \pi$$

   D = diameter of wheel in inches

   $\pi = 3.14$
5. Check maximum speed in machinist's handbook to insure calculated speed is within handbook specifications.
6. Accept or reject calculations.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 2019, 1984.

1.0 **COMPETENCY/SKILL:** Performs mathematical calculations necessary to complete machine work.

1.11 **TASK:** Calculates sine-bar dimensions for machine set-up.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a surface plate, 5" sine bar, gage blocks, machinist's handbook, blueprint, and workpiece,

EVALUATION: calculates sine-bar dimensions for machine set-up.

STANDARD: Use formula, locate information in reference material, use gage blocks in set-up, angle meets blueprint specifications, and angle rounded to the nearest whole minute.

STUDENT LEARNING EXPERIENCES:

1. Check print for angle needed.
2. Calculate gage block buildup using the formula:

   Buildup = 5 x sine fo the required angle (find sine of angle in machinist's handbook)
3. Select gage blocks that match answer and put sine bar end on top of blocks.
4. Set workpiece on sine bar and clamp work to angle plate.
5. Check calculations and work, accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division. McGraw-Hill Book Company, Novato, CA., pp. 39-40, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division. McGraw-Hill Book Company, Novato, CA., pp. 71-74, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 66-67, 1984.

1.0 **COMPETENCY/SKILL:** Performs mathematical calculations necessary to complete machine work.

1.12 **TASK:** Calculates gear blank specifications.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a gear blank, gear tables, workpiece, reference material, and blueprint,

EVALUATION: calculates gear blank specifications.

STANDARD: Use formulas to find outside diameter of gear blank, depth of tooth, tooth thickness, chordal addendum, and chordal thickness, calculations to meet print specifications.

STUDENT LEARNING EXPERIENCES:

1. Study blueprint.

2. Determine diametrial.

3. Calculate outside diameter
   a. Use formula: $OD = \frac{N + 2}{P}$

      OD = outside diameter
      N = number of teeth
      P = diametrial pitch

   b. Check answer with handbook

4. Calculate depth of tooth
   a. Use formula: $d = \frac{2.157}{P}$

      d = depth of tooth
      P = diametrial pitch

   b. Check answer with handbook or cutter

5. Calculate tooth thickness
   a. Use formula: $t = \frac{1.5108}{P}$

      t = tooth thickness
      P = diametrial pitch

b. Check handbook for answer

6. Calculate addendum
   a. Use formula: $a = \frac{1.0}{P}$

      a = addendum
      P = diametrial pitch

7. Calculate chordal addendum
   a. Use formula: $ca = a + \frac{t^2}{4D}$

      ca = chordal thickness
      D = outside diameter
      a = addendum
      t = tooth thickness

8. Calculate chordal thickness
   a. Use formula: $ct = D \sin \frac{(90)}{N}$

      ct = chordal thickness
      D = outside diameter
      N = number of teeth

   b. Check answer with handbook

9. Check calculations with handbook and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division. McGraw-Hill Book Company, Novato, CA., pp. 282-284, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division. McGraw-Hill Book Company, Novato, CA., pp. 370-375, 1984.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 694-699, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 333-340, 1984.

2.0 **COMPETENCY/SKILL:** Designs and plans machine work according to instructions, drawings and handbook references

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2.1 **TASK:** Identifies appropriate drafting symbols

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a blueprint, worksheet, and reference material,

EVALUATION: identifies appropriate drafting symbols.

STANDARD: Locate symbols in reference material, apply knowledge common lines used in blueprints, find specific information located on print, understand symbols on blueprint to be able to complete part.

STUDENT LEARNING EXPERIENCES:

1. Inspect print for general information.
2. Check title box for information asked on worksheet.
3. Find information needed to build part, material, general dimensions, length, width, height, surface finish.
4. Inspect print for special notes, and symbols, counterbore, hardened, threads, and radius.
5. Use reference material to identify unknown symbols.
6. Complete worksheet and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 91-93. 1984.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 25-27. 1984.

Taylor, David L. ELEMENTARY BLUEPRINT READING FOR MACHINISTS. Delmar Publishing Company, Albany, NY. pp. 13-17. 1986.

2.0 **COMPETENCY/SKILL:** Designs and plans machine work according to instructions, drawings and handbook references

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2.2 **TASK:** Follows written or verbal instructions and footnotes

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a workpiece, written information, and verbal instructions,

EVALUATION: follows written or verbal instructions and footnotes to complete part.

STANDARD: Workpiece meets written and verbal instructions.

STUDENT LEARNING EXPERIENCES:

1. Review written information and ask questions about unclear information.
2. Listen to the instructions given and write down specific information to help remember instructions.
3. Proceed building the part with information received.
4. Clarify information while building part. Refer back to original person who gave information and details.
5. Inspect part and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

2.0 **COMPETENCY/SKILL:** Designs and plans machine work according to instructions, drawings and handbook references

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2.3 **TASK:** Interprets and works from multi-view drawings

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a workpiece, blueprint with multi-view drawing, measuring instruments, and machine equipment,

EVALUATION: interprets and works from multi-view drawing.

STANDARD: Finished part looks like and meets multi-view drawing specifications.

STUDENT LEARNING EXPERIENCES:

1. Review drawing and visualize what part looks like.
2. Check drawing for dimensions and material needed to build part.
3. Build part using information from the different views.
4. Inspect finished part and either accept or reject part according to drawing specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Barsamian, Michael A. and Richard A. Gizelbach. MACHINE TRADES PRINT READING. Goodheart-Willcox Company, Inc. South Holland, IL. pp. 50-63. 1986.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA. pp. 62-64. 1982.

Taylor, David L. ELEMENTARY BLUEPRINT READING FOR MACHINISTS. Delmar Publishing Company, Albany, NY. pp. 28-43. 1986.

2.0 **COMPETENCY/SKILL:** Designs and plans machine work according to instructions, drawings and handbook references

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2.4 **TASK:** Interprets size and location dimensions

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a blueprint,

EVALUATION: interprets size of part and location dimensions.

STANDARD: Knows length, width, height dimensions, and can interpret dimensions needed to locate special machine operations.

STUDENT LEARNING EXPERIENCES:

1. Review print and find general overall dimensions, length, width, height.
2. Check print for location dimensions.
3. Review location dimensions and decide if addition or subtraction work is required to find machine locations.
4. Build part checking print and math calculations and accept or reject finished part.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Barsamian, Michael A. and Richard A. Gizelbach, Machine Trades Print Reading. Goodheart-Wilcox Company, Inc. South Holland, IL. pp. 166-186, 1986.

Taylor, David L. ELEMENTARY BLUEPRINT READING FOR MACHINISTS. Delmar Publishing Company, Albany, NY. pp. 52-64. 1986.

2.0 **COMPETENCY/SKILL:** Designs and plans machine work according to instructions, drawings and handbook references

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2.5 **TASK:** Works from sketches

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a workpiece, measuring instruments, reference material, machining equipment, and sketch,

EVALUATION: works from sketches.

STANDARD: Produced machine parts meet sketch specifications.

STUDENT LEARNING EXPERIENCES:

1. Review sketch and ask questions if needed.
2. Machine part.
3. Inspect part for size dimensions and accept or reject work according to sketch.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

2.0 **COMPETENCY/SKILL:** Designs and plans machine work according to instructions, drawings and handbook references

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2.6 **TASK:** Uses Machinery's Handbook as reference

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a blueprint, and Machinery's Handbook,

EVALUATION: uses the Machinery's Handbook as reference.

STANDARD: Uses the Machinery's Handbook to look up specific information located on the blueprint.

STUDENT LEARNING EXPERIENCES:

1. Review print and locate unknown specifications.
2. Use general contents to locate information.
3. Use the comprehensive index to find specific information located in the back of the book.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Oberg, Eric. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY. pp. xi. 1984.

2.0 **COMPETENCY/SKILL:** Designs and plans machine work according to instructions, drawings and handbook references

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2.7 **TASK:** Visualizes part from drawing

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a multi-view blueprint drawing, and several similar built parts,

EVALUATION: visualizes part from the drawing.

STANDARD: Picks part out of group with similar designs.

STUDENT LEARNING EXPERIENCES:

1. Review blueprint and locate the top, front, and right side view.
2. Look at the drawing and position yourself in your mind to be looking down at the part from the top view.
3. Turn the part and visualize the part as you look at the front checking for hidden lines.
4. Turn the part so that you are looking at it from the right side and check for hidden lines.
5. Check the group of parts and select the part that matches the print.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Barsamian, Michael A. and Richard A. Gizelbach MACHINE TRADES PRINT READING. Goodheart-Willcox Company, Inc. South Holland, IL. pp. 9-16. 1986.

2.0 **COMPETENCY/SKILL:** Designs and plans machine work according to instructions, drawings and handbook references

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2.8 **TASK:** Makes sketches of work to be machined

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a Machinery's Handbook, caliper, steel rule, and workpiece,

EVALUATION: makes sketches of work to be machined.

STANDARD: Sketch has all views shown, all views dimensioned, and part meets job specifications.

STUDENT LEARNING EXPERIENCES:

1. Study workpiece and sketch views of missing part.
2. Dimension sketch by measuring workpiece, and calculating dimension needed for machining part.
3. Refer to Machinery's Handbook for specific information and details.
4. Check sketch dimensions against machining requirements.
5. Accept or reject sketch depending on job specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA. pp. 66-68. 1982.

2.0 **COMPETENCY/SKILL:** Designs and plans machine work according to instructions, drawings and handbook references

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2.9 **TASK:** Calculates missing dimensions

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a blueprint,

EVALUATION: calculates missing dimensions.

STANDARD: Calculated dimensions keep part within print specifications.

STUDENT LEARNING EXPERIENCES:

1. Review blueprint and observe missing dimensions.
2. Decide if missing dimension can be found through adding or subtracting from other dimensions.
3. Check print for actual size and use steel rule to measure checking for calculation errors.
4. Build part and measure.
5. Accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

2.0 **COMPETENCY/SKILL:** Designs and plans machine work according to instructions, drawings and handbook references

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2.10 **TASK:** Applies company standards

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a copy of a company policy with maximum and minimum conditions allowable, time limitation, shipping and receiving,

EVALUATION: applies company standards.

STANDARD: Meets time limitation, shipping and receiving meets company standards, completed part meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Review company standards.
2. Inspect parts for tolerances, dimensions, finishes, and print specifications.
3. Part completed on deadline or earlier.
4. Oversee the part from the raw material to finished product stages.
5. Supervise the method used to ship product and to receive product.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.1 **TASK:** Measures work with a tape measure.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a tape measure, workpiece, and blueprint,

EVALUATION: measures work with a tape measure.

STANDARD: Workpiece measured within tolerances specified on the blueprint.

STUDENT LEARNING EXPERIENCES:

1. Deburr and clean workpiece.
2. Hook rule over edge of workpiece and measure to length.
3. Scribe line or mark line at distance specified on print.
4. Check workpiece dimensions and approve or reject work according to tolerances.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.2 **TASK:** Measures work with a 6" pocket scale.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a pocket rule, workpiece, and blueprint,

EVALUATION: measures work with a 6" pocket scale.

STANDARD: Measurement of workpiece to be held within tolerances specified by the blueprint.

STUDENT LEARNING EXPERIENCES:

1. Deburr and clean workpiece.
2. Check blueprint for required dimensions.
3. Line up the one inch line of the scale with the end of the workpiece, avoid using end of scale because of possible wear on scale.
4. Allow for this one inch when calculating measurements.
5. If measuring an end diameter, move scale back and forth until largest reading is obtained.
6. Check measurement and accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 4-8, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 39-40, 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 80, 1982.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.3 **TASK:** Layouts work with combination square.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a combination square, workpiece, scriber, layout die, prick and center punch, hammer, and blueprint,

EVALUATION: layouts work with a combination square.

STANDARD: Layout of workpiece will meet print specifications.

STUDENT LEARNING EXPERIENCES:

1. Deburr and clean workpiece.
2. Use layout die and coat surface.
3. Select reference surface or edge on workpiece.
4. Scribe one end of workpiece allowing room for complete layout of work.
5. Scribe perpendicular line to reference edge.
6. Scribe centerlines of arcs and holes.
7. Prick punch hole locations on centerlines, if location is correct then center punch mark.
8. Scribe arcs and holes.
9. Scribe outline of workpiece and other details.
10. Check layout with print then accept or reject work according to specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 104-105, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 25-27, 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 81-82, 1982.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.4 **TASK:** Cares for precision instruments. (Do not use libricant with oil base. Oil collects dust, dust is abrasive.)

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a micrometer, calipers, dial indicator, vernier depth and height gage, rags, cleaning solution, storage cases, and storage cabinets, (Don't store micrometers with anvils.)

EVALUATION: cares for precision instruments.

STANDARD: Clean equipment and lubricate to prevent rust, store in correct storage cases.

STUDENT LEARNING EXPERIENCES:

1. Remove all metal filing and grease for instruments.
   a. Apply cleaning solution and wipe surface clean and dry.
2. Remove all rust from instruments using rust remover and crocus cloth.
3. Coat lightly all bright surfaces with lubricant.
4. Check instruments for adjustments and zero readings and align.
5. Place instruments in storage cases and place in storage cabinets.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 17-37. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, Ca. pp. 69, 78.

1984.

Operator's Manual.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.5 **TASK:** Measures work with a slide caliper rule.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a slide caliper rule, micrometer, workpiece, and blueprint,

EVALUATION: measures work with a slide caliper rule.

STANDARD: Measured work meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Deburr and clean workpiece.
2. Check and set slide caliper rule with a micrometer.
3. Measure workpiece by sliding movable jaws against the workpiece.
4. Lock jaws and check measurement.
5. Approve or reject work according to specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 32-33. 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 62. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 25. 1982.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.6 **TASK:** Measures work with dial calipers.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a dial caliper, workpiece and blueprint,

EVALUATION: measures work with dial calipers.

STANDARD: Take care while using calipers, measure workpiece to meet blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Deburr and clean workpiece to be measured.
2. Check print for dimensions.
3. Check dial caliper for zero reading and set if necessary.
4. Open caliper jaws until outside or inside jaws touch surface to be measured.
5. Measure across centerline with light touch and take reading.
6. Read caliper by reading number on main scale of handle and add dial reading to it.
7. Check readings with print and accept or reject work according to print specifications.
8. Take measurements square to X-Y axis to eliminate paralax.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 55-56. 1984.

Operator's Manual

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools

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3.7 **TASK:** Measures work with outside micrometer

PERFORMANCE OBJECTIVE:

CONDITIONS: Given an outside micrometer, workpiece and blueprint,

EVALUATION: measures work with outside micrometer.

STANDARD: Measured workpiece readings will meet blueprint specifications, take care while using the micrometer, list nomenclature, take care to return to storage case.

STUDENT LEARNING EXPERIENCES:

1. Deburr and clean surface of workpiece to be measured.
2. Select micrometer that will fit stock size.
3. Clean anvil and spindle then check zero setting and adjust if necessary.
4. Measure workpiece with micrometer.
   a. Use finger touch (lightly).
   b. Use ratchet for consistent pressure.
   c. Take second reading 90 degrees from first reading on round stock.
   d. Hold micrometer on stock while taking reading, if need to remove, apply lock on micrometer.
   e. If part is larger than one inch remember to include that size.
5. Check part with print tolerances and accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 18-20. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 47-49. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 42-44. 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA. pp. 103-105. 1982.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools

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3.8 **TASK:** Measures work with depth micrometer

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a depth micrometer, measuring rods, machined workpiece, and blueprint,

EVALUATION: measures workpiece with depth micrometer.

STANDARD: Depth measurement meets print specifications. Select measuring rod, use care while using depth micrometer. Return micrometer to storage case and cabinet.

STUDENT LEARNING EXPERIENCES:

1. Deburr and clean workpiece.

2. Select measuring rod and insert in micrometer, check micrometer for zero setting and adjust if necessary.

3. Set micrometer on reference surface and turn thimble until rod touches bottom of surface being measured.
   a. Hold micrometer base firmly on reference surface.
   b. Use light touch when turning thimble to prevent rod damage and lifting of base.

4. Remove micrometer and take reading, reading is backwards from other micrometers.

5. Take several readings to check measurements.

6. Accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 32-33. 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 61-62. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 40-41. 1984.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools

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3.9 **TASK:** Measures work with depth gages

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a rule depth gage, vernier depth gage, Machinery's Handbook, machined workpiece and blueprint,

EVALUATION: measures work with depth gage.

STANDARD: Check workpiece with depth gages and accept or reject part according to blueprint specifications.

STUDENT LEARNING EXPERIENCES:

Rule depth gage

1. Deburr and clean workpiece surface.
2. Slide rule as far down the hole without disturbing contact of gage head and work.
3. Tighten gage clamp nut and remove from hole.
4. Read depth dimension on rule at junction with gage head.
5. Check part with print and accept or reject part according to tolerances.

Vernier depth gage

1. Clean and deburr workpiece surface.
2. Set vernier gage on reference surface and insert rule to bottom of hole, holding base firmly on surface, lock rule on place with lock screw, then adjust vernier movement until light contact is made.
3. Remove gage and read vernier setting (Machinist's Handbook for reference on reading vernier scale).
4. Check readings with print and accept or reject part according to print tolerances.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 43-44. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 62. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 47. 1984.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools

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3.10 **TASK:** Measures inside and outside diameters with vernier calipers

PERFORMANCE OBJECTIVE:

CONDITIONS: Given an inside-outside vernier caliper, Machinery's Handbook, workpiece, and blueprint,

EVALUATION: measures inside and outside diameters with vernier calipers.

STANDARD: Measurements taken must meet blueprint specifications, take care while using calipers, calipers returned to storage case and cabinet.

STUDENT LEARNING EXPERIENCES:

1. Deburr and clean workpiece.
2. Select caliper and check for zero setting, adjust if necessary.
3. Slide caliper jaws till jaws touch inside diameter of walls.
4. Avoid excessive pressure to prevent jaws from bending.
5. Read caliper while in place on the workpiece.
6. Repeat measurement and check with blueprint to find specifications.
7. Repeat steps 3-5 for outside measurements.
8. Accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 22-23. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 54-55. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 45-46. 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA. pp. 106-108. 1982.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools

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3.11 **TASK:** Measures work with ring and plug gages

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a workpiece, GO and NO-GO plug gages, GO and NO-GO ring gages, and blueprint,

EVALUATION: measures work with ring and plug gages.

STANDARD: Select gages that meet print specifications, take care while using gages, workpiece approved or rejected according to print specifications.

STUDENT LEARNING EXPERIENCES:

1. Clean and deburr workpiece.
2. Check workpiece with GO gage and gage should fit.
3. Check workpiece with NO-GO gage and gage should not fit.
4. Repeat steps 2-3 with all gages to check workpiece.
5. Accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 214-215. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 77-78. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 64-65. 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA. pp. 547-548. 1982.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools

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3.12 **TASK:** Measures work with telescope and hole gage.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a telescoping gage, small hole gage, micrometer, workpiece, and blueprint,

EVALUATION: measures workpiece with telescope and hole gage.

STANDARD: Measured workpiece meets print specification for acceptance, care used with tools while measuring, gages returned to storage case and cabinet.

STUDENT LEARNING EXPERIENCES:

1. Deburr and clean workpiece.

2. Review print and select gages for desired measurements.

3. Insert gages in hole or slot and adjust gage to fit workpiece.

Small hole gage
   a. Select gage and adjust gage until it touches workpiece.
   b. Move gage back and forth to obtain measurement.
   c. Remove gage from workpiece and measure with micrometer.

Telescoping gage
   a. Select gage and insert into workpiece.
   b. Rock gage to obtain largest measurement and lock.
   c. Remove gage and measure with micrometer.

4. Avoid excessive pressure on gages while measuring gage with micrometer.

5. Repeat steps for second reading.

6. Review print specifications and measurements.

7. Accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 31-32. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 59-60. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 33, 55. 1984.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools

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3.13 **TASK:** Measures work with inside micrometer.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given an inside micrometer, extension rods, spacing collar, handle, workpiece, and blueprint,

EVALUATION: measures workpiece with inside micrometer.

STANDARD: Select extension rod, assemble micrometer, measurements of part meets print specifications. Take care while using micrometer, equipment returned to storage case and cabinet.

STUDENT LEARNING EXPERIENCES:

1. Check approximate inside diameter with steel rule.
2. Assemble extension rod in micrometer, checking shoulder setting and length of micrometer with steel rule.
3. Use spacing collar if necessary.
4. Mount handle to micrometer and lower inside hole.
5. Hold one end firmly against side of hole and move other end in an arc movement until largest setting is obtained.
6. Read micrometer reading and add extension rod length plus collar if used.
7. Take several readings and approve or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 29-30. 1983.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 40. 1984.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools

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3.14 **TASK:** Measures work on surface plate.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a surface plate, V-blocks, height gage, gage blocks, dial indicator and stand, workpiece and blueprint,

EVALUATION: measures work on surface plate.

STANDARD: Set up workpiece on surface plate, the part measured meets print specifications, use care with gages and equipment, equipment returned to storage cases and cabinets.

STUDENT LEARNING EXPERIENCES:

1. Clean surface plate and check for nicks and burrs.
2. Carefully place work on surface plate to prevent damage to surface.
3. Set work on V-blocks.
4. Set up work for measurement, build gage blocks to print specifications, mount dial indicator to stand and place on surface plate.
5. Take measurement of workpiece, align dial indicator to gage blocks and set dial indicator to zero reading, place dial indicator against surface of workpiece.
6. Read dial indicator measurements and record.
7. Accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 11-12, 50. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 45-46, 102-103. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 31. 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA. pp. 79-80. 1982.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools

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3.15 **TASK:** Measures work with height gages.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a vernier height gage, surface plate, workpiece, and blueprint,

EVALUATION: measures workpiece with a height gage.

STANDARD: measured workpiece must meet print specifications, take care while using equipment, equipment returned to storage cases and cabinets.

STUDENT LEARNING EXPERIENCES:

1. Clean and deburr workpiece.
2. Clean surface plate and check for nicks and burrs and remove if necessary.
3. Set workpiece and height gage on surface plate.
4. Assemble offset scriber in height gage and set to zero setting on surface plate.
5. Slide vernier scale so scriber is just above height to be measured and lock scale.
6. Turn fine adjustment until scriber touches workpiece and lock adjustment knob.
7. Take reading on scale adding inches from beam.
8. Check print with readings and accept or reject workpiece according to specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 33-34. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 62-65. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 46. 1984.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools

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3.16 **TASK:** Measures work with gage blocks.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a workpiece, gage blocks, gage pins, height gage attachment, surface plate and cleaner, lint free tissue, and blueprint,

EVALUATION: measures workpiece using gage blocks.

STANDARD: Use care with equipment, equipment returned to storage cases and cabinets when finished. Correct amount of block used to establish height, wringing gage blocks together. Workpiece meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Check print for dimensions and specifications of tolerances.
2. Clean workpiece and place on surface plate.
3. Calculate and select gage blocks necessary to measure workpiece.
4. Clean blocks and wring blocks together.
5. Add attachments to gage blocks and measure workpiece.
6. Check workpiece dimensions with print and accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 35-38. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 66-69. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 57-62. 1984.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools

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3.17 **TASK:** Measures work with indicators and attachments.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a work-holding device, dial indicator and attachments, precision measuring instrument, workpiece and blueprint,

EVALUATION: measures work with indicators and attachments.

STANDARD: Mount workpiece securely in work-holding device, take care while using indicators and attachments, return equipment to storage cases and cabinets, workpiece meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Clean and deburr workpiece.
2. Select indicator and attachments to be used.
3. Mount workpiece in work-holding device.
4. Adjust workpiece for rough alignment.
5. Clamp indicator into position.
6. Contact workpiece lightly with indicator and set dial indicator on zero.
7. Move indicator or workpiece along indicator tip and record readings.
8. Adjust workpiece until tolerances are obtained.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 41-42. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 80-82. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 52-57. 1984.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools

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3.18 **TASK:** Measures work with thread wires.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a Machinery's Handbook, thread measuring wires, micrometer, threaded workpiece, and blueprint,

EVALUATION: measures work with thread wires.

STANDARD: Workpiece must meet print specifications, take care with equipment while using it, put equipment in storage cases and return to cabinets.

STUDENT LEARNING EXPERIENCES:

1. Clean and deburr workpiece.
2. Select micrometer and check for zero setting, adjust if necessary.
3. Check Machinery's Handbook for formula and select thread measuring wires, measure wires with micrometer to check size.
4. Place two wires on one side and one wire on the opposite side.
5. Using light pressure, measure distance using micrometer.
6. Check print specifications and calculate diameter with handbook formula.
7. Accept or reject workpiece according to print tolerances.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 283-284. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 118. 1984.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY. pp. 1373-1390. 1984.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.19 **TASK:** Measures work with pitch micrometer.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a threaded workpiece, pitch micrometer with anvil and spindle inserts, and blueprint,

EVALUATION: measures workpiece with pitch micrometer.

STANDARD: Workpiece meets print specifications, select anvil and spindle insert, take care with equipment, return equipment to storage cases and cabinets.

STUDENT LEARNING EXPERIENCES:

1. Clean and deburr workpiece.
2. Select pitch micrometer with anvil and spindle inserts to match workpiece threads.
3. Check micrometer for zero setting and adjust if necessary.
4. Place workpiece between the thread micrometer and adjust micrometer until anvil and spindle touch workpiece lightly.
5. Read micrometer and take three different location readings.
6. Check print specifications with readings and accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 14-15. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 51-52. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 117. 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA. pp. 100-101. 1982.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.20 **TASK:** Layouts work on surface plate.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a surface plate, surface gage, height gage, scriber, layout dye, prick punch, and blueprint,

EVALUATION: layout workpiece on surface plate.

STANDARD: Layout lines meet print specifications, take care with use of equipment, return equipment to storage cases and cabinets.

STUDENT LEARNING EXPERIENCES:

1. Clean and deburr workpiece.
2. Coat surface with dye and let dry.
3. Mount and clamp workpiece to angle plate.
4. Scribe a reference line on workpiece with vernier height gage.
5. Scribe remaining lines needed to layout workpiece.
   a. Scribe all horizontal lines.
   b. Scribe angular lines using protractor.
   c. Scribe arcs and circles with dividers.
6. Check scribed lines with print specifications and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.21 **TASK:** Layouts work with hermaphrodite calipers.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a hermaphrodite caliper, combination square, prick punch, hammer, layout dye, flat workpiece, round workpiece, and blueprint,

EVALUATION: layout workpiece with hermaphrodite calipers.

STANDARD: Scribed line runs parallel to edge of flat stock, locate center of round stock, workpieces meet print specifications.

STUDENT LEARNING EXPERIENCES:

Scribe line parallel to an edge on flat stock.

1. Clean and deburr workpiece.
2. Set hermaphrodite calipers to designated dimension.
3. Coat workpiece with layout dye and let dry.
4. Place hooked leg against edge of workpiece and move calipers along edge of workpiece.
5. Check layout line for print tolerances and accept or reject work.

Locate center of round stock.

1. Clean and deburr workpiece.
2. Coat end of stock with layout dye.
3. Set caliper legs at one half diameter of workpiece.
4. Place hooked leg against workpiece and scribe an arc.
5. Rotate workpiece 90 degrees and repeat arc, do this four times.
6. Prick punch center of arc lines.
7. Check location with scale and accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 54-141. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 104. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA. pp. 97. 1982.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.22 **TASK:** Checks work with sine bar.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a sine bar, gage blocks, surface plate, angle plate, clamps, dial indicator and stand, Machinist's Handbook, workpiece, and blueprint,

EVALUATION: checks work with sine bar.

STANDARD: Select gage blocks for required height, mount stock to angle plate with clamps, finished workpiece meets print specifications, use care with equipment, equipment returned to storage cases and cabinet.

STUDENT LEARNING EXPERIENCES:

1. Clean surface plate and angle plate.
2. Determine angle needed with prints and check Machinist's Handbook for gage block assembly.
3. Select sine bar and wring gage blocks together.
4. Place sine bar end on gage blocks and against angle plate.
5. Assemble dial indicator to stand and set indicator tip against sine bar and set to zero.
6. Clamp workpiece to angle plate and align workpiece with dial indicator.
7. Accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 71-74, 114-116. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 66-68. 1984.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY. pp. 1573-1574. 1984.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.23 **TASK:** Checks work with surface gages.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a surface gage, combination square, surface plate, workpiece and blueprint,

EVALUATION: checks workpiece with a surface gage.

STANDARD: Set surface gage to meet print specifications, workpiece is within tolerances specified on the print.

STUDENT LEARNING EXPERIENCES:

1. Clean and deburr workpiece.
2. Clean surface plate and place surface gage carefully on plate.
3. Set surface gage to workpiece height.
4. Check height setting of gage against combination square.
5. Check workpiece height and accept or reject.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 53. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 105-106. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 224. 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA. pp. 86. 1982.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.24 **TASK:** Checks work with radius gages.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a workpiece, radius gages, hone, files, and blueprint,

EVALUATION: checks work with radius gages.

STANDARD: Workpiece fits gage so not light shows between gage and blueprint.

STUDENT LEARNING EXPERIENCES:

1. Select radius gage according to print specifications.
2. Place gage on centerline of workpiece and check for light between gage and workpiece.
3. Re-machine workpiece if high spots appear.
4. File high spots if possible.
5. Repeat steps 3-4 until gage fits workpiece.
6. Accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.25 **TASK:** Measures work with spring calipers.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a workpiece, spring calipers, steel rule and blueprint,

EVALUATION: measures work with spring calipers.

STANDARD: Set calipers, measurements meet print specifications.

STUDENT LEARNING EXPERIENCES:

1. Select spring calipers needed to take measurements.
2. Clean and deburr workpiece.
3. Adjust caliper to workpiece, hold one leg against workpiece and adjust other leg to touch workpiece lightly.
4. Measure caliper setting, hold one leg at end of scale and read other leg position, scale 1/64 scale preferred.
5. Check measurements with print specifications and approve or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 8-10. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 40-42. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 35-37. 1984.

3.0 **COMPETENCY/SKILL:** Performs precision measurements accurately using a variety of tools.

3.26 **TASK:** Checks work with optical comparator.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given an optical comparator, workpiece, and blueprint,

EVALUATION: checks workpiece with optical comparator.

STANDARD: Workpiece measurements meet print specifications, set workpiece on comparator square, focus comparator, read X and Y axis dimensions.

STUDENT LEARNING EXPERIENCES:

1. Clean and deburr workpiece.
2. Mount workpiece on V-block.
3. Set workpiece on comparator evenly.
4. Turn on comparator and set cross hair marks at end of workpiece.
5. Take readings and compare with print specifications.
6. Accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 43. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 83-84. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 78. 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.1 **TASK:** Inspects work area for safe working environment.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given inspection sheet, pencil, work area to cover, and instructions,

EVALUATION: inspects work area for safe working environment.

STANDARD: All unsafe conditions reported to instructor, all items on inspection sheet must be marked safe or unsafe.

STUDENT LEARNING EXPERIENCES:

1. Inspect machine tools, safety devices, guards, exhaust, ventilation, attachments returned to storage, scrap metal removed, controls in good conditions.

2. Hand tool inspection, stored properly, clean, well maintained.

3. Personal protection equipment, foot wear, eye protection, head protection, first-aid equipment, fire extinguisher.

4. Signs located where needed, and visible.

5. Floors, passageways, aisles, space around machines, clear of metal scrap and stock, clearly marked safety zones, free from oil, grease, and other liquids.

6. Disposal cans located in appropriate locations and emptied daily.

7. Complete form and return to instructor.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 62-64, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, Ca., pp. 18-22, 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.2 **TASK:** Cares for hand tools.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a file, saw, pliers, vices, hammer, chisels, screwdriver, wrenches, taps, dies, hand reamers, and job specifications or manufacturer's standards,

EVALUATION: cares for hand tools.

STANDARD: Hand tools must meet job specifications of manufacturer's standards. Inspect and provide care.

STUDENT LEARNING EXPERIENCES:

1. Inspect hand tools and determine damage
   a. Cutting tools sharp wiht no broken teeth or mushroomed heads
   b. Clamping tools have clean jaws
   c. Soft jaws available for vises
   d. Screwdrivers have correct shaped blade
2. Obtain any needed parts
   a. Dismantle and replace damaged parts
   b. Make required adjustments
3. Sharpen dull tools
   a. Check for mushroomed heads
   b. Check angle of cutting edge
   c. Regrind shape as required

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Feirer, John L. GENERAL METALS. 5th Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 127-130, 1981.

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 66-75, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 118-128, 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 112-128, 1982.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.3 **TASK:** Cuts material with hand hacksaw.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a hacksaw frame, blade, work-holding device, workpiece, files, and blueprint,

EVALUATION: cuts material with a hand hacksaw.

STANDARD: Workpiece is mounted securely, blade selection, strokes used per minute (approx.) part filed when done, part meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Select blade according to metal thickness.
2. Mount in hacksaw frame, with teeth pointing away from handle.
3. Mount workpiece securely in work-holding device.
4. Saw workpiece to specifications.
5. Inspect work and either accept or reject part.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 70-71, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 123-124, 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 112-115, 1982.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.4 **TASK:** Bench files workpiece.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a selection of files, file card, vise with soft jaws, measuring instruments, workpiece and blueprint,

EVALUATION: bench files workpiece.

STANDARD: Mount workpiece securely in vise, select files used, files used with care, part meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Select file and inspect handle for tightness, file clean.
2. Mount workpiece between soft jaws to prevent damage to part and secure.
3. Test for flatness and/or angle of work.
4. Check for pinning.
5. File till part meets specifications using forward strokes.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 71-74, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 124-127, 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 121-127, 1982.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.5 **TASK:** Marks locations with prick punch and center punch.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a center punch, prick punch, hammer, workpiece, and blueprint,

EVALUATION: mark location with prick punch and center punch.

STANDARD: Punches inspected for sharpness, location of mark according to print specifications.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece and check blueprint for hole location.
2. Mark center location with prick punch making a light mark for inspection.
3. Check punch mark with print specification and adjust if necessary.
4. If correction is needed point punch slightly in direction of correction and tap lightly to pull mark over.
5. Center punch hole location, tap punch hard for deep punch mark.
6. Inspect hole location with print and accept or reject.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 48, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 106, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 30-31, 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 86-92, 1982.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.6 **TASK:** Locates holes with transfer screws and transfer punches.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a transfer screw, transfer punch, hammer, pliers, template, work-holding device, clamps, workpiece, and blueprint,

EVALUATION: locates holes with transfer screw and transfer punch.

STANDARD: Transfer screw and punch should be in good condition before using, mark locations to meet blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in work-holding device.
2. Check blueprint for location and size of holes then select transfer tools, threaded holes use transfer screws, straight holes use transfer punches.
3. Locate holes on workpiece from template
   a. Insert transfer screw, if required (extend 1/32")
   b. Position template over workpiece and tap lightly
   c. Clamp template to workpiece for transfer punches
   d. Insert transfer punch in template hole and tap lightly
   e. Remove punch and template, and center punch marks
4. Check hole location against blueprint specification and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 213, 1984.

Repp, Victor E. METALWORK TECHNOLOGY PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 172-173, 1982.

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4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.7 **TASK:** Drills holes with portable drill.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a portable drill, drills, center punch, hammer, work-holding device, workpiece, and blueprint,

EVALUATION: drills holes with portable drill.

STANDARD: Workpiece is mounted securely, hole location and size meets print specifications, demonstrate safety precautions while using portable drill.

STUDENT LEARNING EXPERIENCES:

1. Locate and center punch workpiece according to print specifications.
2. Mount workpiece in work-holding device.
3. Select drills and inspect for sharpness and size.
4. Mount drill in portable drill and tighten with chuck key.
5. Drill hole in workpiece holding drill perpendicular to workpiece, reduce feed pressure as drill penetrates workpiece.
6. Deburr hole and check hole for size and location.
7. Accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Johnson, Harold V. TECHNICAL METALS. 2nd Edition. Glencoe Publishing Company, Encino, CA., pp. 120-121, 1981.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.8 **TASK:** Reams holes with hand reamer.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a reamer, work-holding device, drill press, tap wrench, stub center, lubricant, workpiece, and blueprint,

EVALUATION: reams holes with hand reamer.

STANDARD: Select drills and reamer, locate hole to meets print specifications, workpiece is mounted securely on drill press, safety precautions are observed during operation of the drill press.

STUDENT LEARNING EXPERIENCES:

Hand Reaming

1. Secure workpiece in work-holding device.
2. Select reamer and mount in tap wrench.
3. Ream hole, check for squareness to workpiece, use lubricant, turn reamer clockwise only, apply downward pressure lightly.
4. Check hole with gage and accept or reject work.

Hand Reaming with Drill Press

1. Secure workpiece in work-holding device.
2. Select reamer and mount in tap wrench.
3. Mount stub center in drill press spindle.
4. Align stub center with hole on workpiece and clamp to drill press table.
5. Align stub center with reamer center hole.
6. Ream hole, using lubricant, turn clockwise only, apply pressure with hand feed lever lightly.
7. Inspect hole and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 249-252, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 134-135, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 182-183, 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.9 **TASK:** Cuts threads with hand tap.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, work-holding device, hand tap, drills, lubricant, center punch, hammer, tap wrench, thread gage, countersink, workpiece, and blueprint,

EVALUATION: cut threads with a hand tap.

STANDARD: Select drills and taps, workpiece is mounted securely in work-holding device, location and size of tapped hole meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Secure workpiece in work-holding device.
2. Locate hole position and center punch.
3. Select tap drill and drill hole.
4. Select tap and wrench, clamp tap in holder.
5. Tap hole using lubricant, tap is perpendicular to workpiece, turn in clockwise direction one full turn then reverse direction slightly to break chips.
6. Check tapped hole with gage and accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 75-78, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 129-131, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 102-107, 1984.

4.0 COMPETENCY/SKILL: Performs bench work needed in machine work field.

4.10 TASK: Cuts threads with die.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given an assortment of dies, die stock, lubricant, threaded plug gage, work-holding device, measuring tools, workpiece, and blueprint,

EVALUATION: cuts threads with a die.

STANDARD: Workpiece is mounted securely, select die, threaded section meets blueprint specifications and thread gage fits correctly.

STUDENT LEARNING EXPERIENCES:

1. Check print for size and length of thread to be cut.
2. Select die stock and die to be used.
3. Prepare workpiece for threading by grinding a level on the end and machine stock 0.003"-0.005" undersize.
4. Thread workpiece with die using lubricant, and check occasionally for square.
5. Press down and turn one revolution then back up one-half turn to break chips up.
6. Thread part to print length and check with threaded gage.
7. Inspect part and check with print specifications and either accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 79-80, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 132, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 113-116, 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.11 **TASK:** Broach workpiece with broaching tool.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a arbor press, broaching tool, work supports, broaching guide, precision measuring instruments, workpiece, and blueprint,

EVALUATION: broach workpiece with broaching tool.

STANDARD: Workpiece is mounted securely, select broaching tool to be used, part meets print specifications after broaching.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece then clean and deburr.
2. Mount work and supports on arbor press.
3. Select broaching tool and guides to be used.
4. Align broaching tool on workpiece and check vertical alignment of broaching tool.
5. Press broaching tool through workpiece using lubricant.
6. Repeat cut with shims if necessary.
7. Check workpiece for measurements and accept or reject.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 84-86, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 135-136, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 379-387, 1984.

4.0 COMPETENCY/SKILL: Performs bench work needed in machine work field.

4.12 TASK: Grinds part with hand grinder.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a portable grinder, wheel assortment, workholding device, workpiece, and blueprint,

EVALUATION: grinds part with a hand grinder.

STANDARD: Mount work securely in work-holding device, select grinding wheel, observe safety precautions while operating grinder, part meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece and mount securely in work-holding device.
2. Select grinding wheel and mount on grinder.
3. Check print for speed to set grinder, finish required, and measurements.
4. Grind workpiece, wearing safety glasses, and guards mounted on wheel.
5. Inspect ground workpiece for finish and size.
6. Accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 2040-2041, 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.13 **TASK:** Assembles or disassembles work with arbor press.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given an arbor press, clamps, workpiece, and blueprint,

EVALUATION: assembles or disassemble work with arbor press.

STANDARD: Remove part using arbor press with minimal damage to part. Replaced part meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Perform set up, place and clamp stationary part to table.
2. Align moveable part in accordance to ram.
3. Remove part using lubricant, and apply pressure to part.
4. Replace part using lubricant, align any keyways or matching parts, press part together.
5. Accept or reject workpiece according to specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 174, 1982.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.14 **TASK:** Straightens workpiece on arbor press.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a arbor press, dial indicator, work-holding device, support blocks, and bent workpiece,

EVALUATION: straightens workpiece on the arbor press.

STANDARD: Area pressure is applied, set up measuring device, straightened part meets specifications.

STUDENT LEARNING EXPERIENCES:

1. Check workpiece bent location and amount of runout with dial indicator.
2. Mark location on workpiece and mount on arbor press.
3. Apply pressure to high points and over bend to allow for the metal spring back.
4. Inspect workpiece with dial indicator and repeat if necessary.
5. Accept or reject workpiece according to specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 174, 1982.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.15 **TASK:** Works and shapes metal with hand-held tools.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a work-holding device, grinding wheel, air grinder, air supply, chuck wrench, portable drill, hand chisels, punches, hammer, workpiece, and blueprint,

EVALUATION: works and shapes metal with hand-held tools.

STANDARD: Safety precautions must be used while operating grinder, workpiece is mounted securely in work-holding device, part meets print specifications.

STUDENT LEARNING EXPERIENCES:

Highspeed Air Grinder

1. Secure grinding wheel in chuck and check air supply.
2. Connect grinder to air supply.
3. Secure workpiece in work-holding device and shape workpiece to specifications.
4. Accept or reject part according to print specifications.

Shape and Work Part to Specifications

1. Use portable hand drill with attachment tools.
2. Select and use sharpened hand chisels and punches.
3. Shape and work part to print specification.
4. Measure part and rework part until part meet print specifications.
5. Accept or reject part.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 126-128, 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.16 **TASK:** Removes and installs dowel pins.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, drills, dowel pins, reamers, pin punch, hammer, pliers, lapping compound, measuring instrument, workpiece, and blueprint,

EVALUATION: removes and installs dowel pins.

STANDARD: Select drills and reamers, select pins, procedure used to remove pins, dowel pins meet print specifications on size and locations.

STUDENT LEARNING EXPERIENCES:

1. Remove damaged dowel pins with prick punch, or screw extractor.

2. Examine hole for damage and repair if necessary.

3. Replace dowel pin(s) in hole that is 0.001" undersize or meets machinist's handbook recommendations.

4. Check locations and fits of parts that mate at designated locations.

5. Accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 87, 1983.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 1022-1027, 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.17 **TASK:** Removes broken drills and taps.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, drills, tap extractors, tap wrench, ahmmer, punches, heat treat oven, pliers, workpiece with broken drill and tap.

EVALUATION: removes broken drills and taps.

STANDARD: Select tools used to remove broken tool, select drills, and tap/screw extractors remove tap/drill, hole repaired and meets print specifications.

STUDENT LEARNING EXPERIENCES:

Broken Tap

1. Check print for tap size and select tap extractor.
2. Remove broken tap
   a. If tap extends beyond work surface use pliers
   b. Extend fingers completely into flutes
   c. Slide sleeve down against workpiece
   d. Work tap back and forth while removing
3. Clean out tapped hole and retap.
4. Accept or reject work.

Broken Drill

1. Check size of broken drill according to print specification.
2. Use pliers if drill extends beyond work surface.
3. If through hole use prick punch and drive out.
4. Anneal drill if workpiece can't be damaged and drill out.
5. Accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 78-79, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 131-132, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 105-106, 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.18 **TASK:** Removes damaged screws.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a portable drill, drills, center punch, tap, tap wrench, hammer, screw extractor, work-holding device, center drill, workpiece with damage screw,

EVALUATION: removes damaged screw.

STANDARD: Select tools used to remove damaged screw, workpiece is mounted securely, select drills, use screw extractor, repair hole after removal of screw.

STUDENT LEARNING EXPERIENCES:

1. Secure workpiece in work-holding device and center punch damaged screw.

2. Center drill damaged screw.

3. Select drill and screw extractor.

4. Remove damaged screw
   a. Insert screw extractor in drilled hole

   b. Turn gently using downward force turning counter clockwise (right hand thread)

5. Clean hole and rethread with tap to original size.

6. Accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 106, 1984.

4.0 COMPETENCY/SKILL: Performs bench work needed in machine work field.

4.19 TASK: Removes frozen or seized parts.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a portable drill, drills, arbor press, penetrating oil, hammer, machine or piece of equipment with frozen or seized part,

EVALUATION: removes frozen or seized part.

STANDARD: Frozen or seized part is to be removed properly without damage to machine or piece of equipment.

STUDENT LEARNING EXPERIENCES:

1. Select proper removal method
   a. Drive out part
   b. Drill our part-use screw extractor
   c. Press out part
2. Soak part seized with penetrating oil.
3. Inspect part for screws or pins holding part together.
4. After removal check part for damage.
5. Accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.20 **TASK:** Installs a helical coil wire insert.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a helical coil wire insert guide, assortment of helical coils, taps, tap wrench, work-holding device, cleaner, lubricant, drill press, drills, workpiece with stripped threaded hole,

EVALUATION: install a helical coil wire insert.

STANDARD: Select tap drill and tap, mount workpiece securely, install helical coil insert meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Secure workpiece in work-holding device.
2. Select tap drill according to helical coil wire screw insert table.
3. Mount drill in drill press and align workpiece.
4. Drill hole then tap using lubricant.
5. Clean hole and install insert.
6. Accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 1185, 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.21 **TASK:** Test workpiece for hardness without hardness tester.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a file and workpiece,

EVALUATION: test workpiece for hardness without hardness tester.

STANDARD: Workpiece is determined as machineable by cutting tools or must be machined by abrasives or carbide tools.

STUDENT LEARNING EXPERIENCES:

1. Select a 3 cornered file, fine teeth.
2. Test workpiece with file
   a. Use corner of workpiece
   b. File on workpiece at non-critical point
3. Determine hardness and recommend machineability of workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 365-366, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 593-602, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 571-576, 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.22 **TASK:** Test workpiece for hardness with hardness tester.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a rockwell hardness tester, anvils, test block, penetrators, steel samples, and abrasive paper,

EVALUATION: test workpiece for hardness with hardness tester.

STANDARD: Readings taken from workpieces to be within 2 points in 3 readings set-up hardness tester.

STUDENT LEARNING EXPERIENCES:

1. Select work to be tested.
2. Select weight, penetrator, scale, and anvil for test.
3. Test machine with test block and adjust if necessary.
4. Remove scale and replace with workpiece on anvil.
5. Apply minor load and set dial on zero.
6. Apply major load letting needle come to a stop.
7. Release major load and read hardness number on scale.
8. Repeat steps 6-8 in different locations and record readings.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 206, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 254, 1984.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 2059-2060, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 243, 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.23 **TASK:** Polishes metal.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, grinder, buffer, assortment of abrasive paper, abrasive, surface finish scale, workpiece, and blueprint,

EVALUATION: polishes metal.

STANDARD: Workpiece is securely mounted in work-holding device or held firmly, finish meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

Lathe Polishing

1. Mount workpiece in lathe.
2. Set spindle speed for three times rpm used for turning.
3. Select abrasive paper and polish workpiece.
4. Use file covered with abrasive paper, take long overlapping strokes.
5. Check diameter and finish frequently.
6. Use finer grit paper successively for finish cuts.
7. Accept or reject work according to print specifications.

Buffing Machine

1. Select buffing wheel and compound.
2. Mount wheel and remove tool rest.
3. Buff workpiece applying compound to wheel.
4. Hold workpiece securely against wheel applying pressure to center of wheel or below center.
5. Do not use gloves or wear long sleeve shirt, point workpiece up into wheel.
6. Check surface for imperfections and polish till removed.
7. Accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 136-138, 1984.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 2050-2054, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 9, 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.24 **TASK:** Laps surface.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lapping block, lapping plate, assortment of abrasives, lubricant, surface finish gage, surface plate, workpiece, and blueprint,

EVALUATION: laps surface.

STANDARD: Select abrasives used, finished surface meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Clean and deburr workpiece surface.
2. Select lapping block or plate.
3. Select lapping powder using roughing lap for new surface.
4. Lap surface, move lap in figure eight motion, avoid heavy pressure, never add fresh abrasive until start new part.
5. Check lapped surface and compare with surface gage.
6. Repeat step 4 until finish surface meets specifications.
7. Accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 2047-2050, 1984.

4.0 **COMPETENCY/SKILL:** Performs bench work needed in machine work field.

4.25 **TASK:** Hones workpiece.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a honing machine, hones, work-holding device, measuring instrument, workpiece, and blueprint,

EVALUATION: hones workpiece.

STANDARD: Honed workpiece meets tolerances in roughness, and straightness, mount workpiece securely in work-holding device.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in work-holding device.
2. Select hole according to print specifications.
3. Mount hones on honing machine and calculate honing speed from machinist's handbook.
4. Hone workpiece checking finish and shape of hole.
5. Continue honing until hole meets print specifications.
6. Accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 2047-2050, 1984.

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.1 **TASK:** Cleans and lubricates drill press.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, brush, cloths, lubricant, cleaning solution, and Operators Manual,

EVALUATION: cleans and lubricates drill press.

STANDARD: Drill press cleaned and lubricated according to Operator's Manual.

STUDENT LEARNING EXPERIENCES:

1. Shut off main power at power box.
2. Clean drill press removing chips with brush.
3. Remove grease and oil with cloths and deburr table.
4. Lubricate drill press wiht a light coat of oil.
5. Grease all fittings, and fill all oil cups.
6. Inspect work and accept or reject.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

DRILL PRESS OPERATOR'S MANUAL

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.2 **TASK:** Inspects and changes drive pulleys and belts.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given an assortment of pulleys and belts, wrenches, pulley puller, hand tools, Machinery's Handbook, and maintenance or repair manual,

EVALUATION: inspects and changes pulleys and belts.

STANDARD: Select pulley and belt, use procedure to remove and mount pulley, all parts and guards in place.

STUDENT LEARNING EXPERIENCES:

1. Turn off electrical power in the main box.
2. Release belt tension and remove.
3. Select replacement belt.
4. Remove and replace pulley.
5. Install new belt and adjust tension according to manual.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

DRILL PRESS OPERATOR'S MANUAL

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.3 **TASK:** Sharpens drill free hand.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill, drill point gage, grinder, wheel dresser, work-holding device, and drill press,

EVALUATION: sharpens drill free hand.

STANDARD: Wheel dressed and trued, drill lip angle match drill gage angle, and drill meets specifications.

STUDENT LEARNING EXPERIENCES:

1. Inspect drill.
2. Dress and true grinding wheel.
3. Position workrest horizontal and within 1/8" of wheel.
4. Turn on grinder and sharpen drill.
5. Hold drill with one hand on workrest at 59 degrees angle to wheel face.
6. Apply pressure against wheel, moving shank end down in an arc motion.
7. Check angle against drill point gage.
8. Check drill for length of cutting edge, angle, and clearance.
9. Mount drill in drill press and drill hole in stock to test.
10. Measure hole and accept or reject drill.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 138-139, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 191-193, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 174-176, 1984.

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.4 **TASK:** Sharpens drill with grinding attachment.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a grinder, drills, drill sharpening manual, drill point gage, drill press, work-holding device, drill grinding attachment, reference book, and micrometer,

EVALUATION: sharpens drill with grinding attachment.

STANDARD: Grinding wheel dressed and trued, drill mounted securely in grinding attachment, all safety procedures followed, sharpened drill fits hole gage and drilled hole meets tolerances.

STUDENT LEARNING EXPERIENCES:

1. Dress and true grinding wheel.
2. Follow Operators Manual for operation of grinder.
3. Grind lip clearance, length, and angles meet specifications.
4. Check drill with drill point gage.
5. Grind each cutting edge until drill fits drill gage.
6. Drill hole in workpiece with drill and measure.
7. Accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 174-175, 1984.

DRILL PRESS OPERATOR'S MANUAL

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.5 **TASK:** Sets up workpiece.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, work-holding device, clamps or bolts, and workpiece,

EVALUATION: sets up workpiece.

STANDARD: Mount workpiece securely, mount work-holding device on table securely, set drill press speed, locate workpiece under drill spindle.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece and mount in work-holding device.
2. Mount work-holding device on drill press table and move until hole location is under spindle.
3. Clamp or bolt work-holding device to table.
4. Check location to be drilled and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 148-149, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 200-201, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 176-179, 1984.

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.6 **TASK:** Drills hole to size.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, work-holding device, drills, center drill, cutting oil, micrometer, clamps/bolts, depth micrometer, workpiece, and blueprint,

EVALUATION: drills hole to size.

STANDARD: Mount work securely to table, set speed of drills, sequence of drills used, hole location and depth, work meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece and holding device to be used.
2. Secure work in work-holding device and mount on drill press table securely.
3. Select center drill and drills to be used.
4. Calculate speed settings for drills.
5. Align workpiece on table with center drill mounted in drill chuck and secure work.
6. Start drill press and center drill work.
7. Select and mount drill and reset speed.
8. Drill to dimension using lubricant.
9. Deburr hole and measure.
10. Accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:
INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, Ca., pp. 150-152, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 202, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 180, 1984.

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.7 **TASK:** Reams hole to size.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, work-holding device, drills, center drill, reamer, micrometer, cutting oil, workpiece, and blueprint,

EVALUATION: reams hole to size.

STANDARD: Mount workpiece securely on drill press table, drill selection and speed settings, select reamers and speed settings, workpiece meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece, and mount in work-holding device.
2. Select drill and set speed of drill press.
3. Mount work-holding device on table and align with center drill of chuck.
4. Check set up and center drill.
5. Mount drill, set speed and drill workpiece (drill smaller than reamer).
6. Mount reamer in drill press and set speed 1/2 drill speed.
7. Ream hole using lubricant and clean then deburr hole.
8. Measure hole and accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 154-160, 1983.

Krar, S.F. TECHNOLGOY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 203-208, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 182-183, 1984.

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.8 **TASK:** Countersinks hole to specifications.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, work-holding device, center drill, countersink, measuring device, workpiece, and blueprint,

EVALUATION: countersinks hole to specifications.

STANDARD: Mount workpiece securely, select countersink, select drill press speed, countersink meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece and center punch hole location.
2. Secure workpiece in work-holding device and mount on drill press table.
3. Mount center drill in chuck and select speed.
4. Center drill workpieces.
5. Mount drill and drill hole.
6. Secure countersink in drill press and align up with hole.
7. Countersink to specifications using cutting oil.
8. Check dimensions and accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 165, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 210, 1984.

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.9 **TASK:** Counterbores hole to specifications.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, work-holding device, clamps/bolts, center drill, drills, counterbore and pilot, cutting oil, measuring device, workpiece, and blueprint,

EVALUATION: counterbores hole to specifications.

STANDARD: Mount workpiece securely on table, select drills, select counterbore, speed settings for drills and counterbore, hole location according to blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece and center punch hole location.
2. Secure work-holding device on table and mount center drill.
3. Center drill workpiece.
4. Mount drill and drill workpieces.
5. Select counterbore and secure in drill press.
6. Counterbore hole to specifications using cutting oil.
7. Measure counterbore and either accept or reject part.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 165-166, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 209-210, 1984.

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.10 **TASK:** Taps hole by hand on drill press.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, tap drills, taps, drill chuck, vise, center drill, thread plug gage, workpiece, and blueprint,

EVALUATION: taps hole by hand on the drill press.

STANDARD: Mount work securely on drill table, select tap drills, select tap according to print specifications, tapped hole meets size and location specifications.

STUDENT LEARNING EXPERIENCES:

1. Select tap and tap drills to be used and calculate speed to be used for drills.
2. Mount workpiece in vise and secure vise on drill table.
3. Mount and align combination drill and countersink to workpiece.
4. Select and set drill press speed.
5. Drill workpiece with tap drill.
6. Mount tap in tap wrench and align to drill hole.
7. Mount dead center in drill chuck and align to tap center.
8. Hand tap hole to specifications using lubricant.
9. Check tapped hole and accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 162-163, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, pp. 210-212, 1984.

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.11 **TASK:** Drills workpiece with drill jig.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, drill jig, drills, clamps, drill bushings, workpiece, and blueprint,

EVALUATION: drills workpiece with a drill jig.

STANDARD: Select speed for drill, mount workpiece on table securely, drill bushings in drill jig, drilled hole located within tolerances of blueprint.

STUDENT LEARNING EXPERIENCES:

1. Place drill bushing in drill jig.
2. Clamp workpiece on drill jig.
3. Mount workpiece and drill jig on drill press table.
4. Select and mount drill in chuck.
5. Adjust table to drill and lower drill into drill bushing.
6. Clamp jig and adjust drill press speed.
7. Drill hole in workpiece using lubricant, raise and lower drill to remove chips.
8. Measure workpiece and accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 214, 1984.

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.12 **TASK:** Mounts work on V-blocks.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, clamps, straps, V-blocks, drills, round workpiece, and blueprint,

EVALUATION: mounts work on V-blocks.

STANDARD: Mount workpiece securely on V-blocks and drill table, select drill and speed setting, hole size and location meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece and center punch hole location.
2. Mount workpiece in V-blocks with center punch located center on top.
3. Clamp workpiece in V-blocks and mount assembly on drill press table.
4. Place center drill in chuck and locate center punch mark on workpiece under point of center drill.
5. Clamp assembly to table and turn on drill.
6. Lightly touch workpiece with center drill and check set up.
7. Accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 147-148, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 183, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 179, 1984.

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.13 **TASK:** Drills hole with automatic feed.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press with automatic feed, work-holding device, drills, micrometer, workpiece, and blueprint,

EVALUATION: drills hole with automatic feed.

STANDARD: Mount workpiece securely on table, select drills and speed settings, drilled hole location and size meet print specifications.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece and mount in work-holding device.
2. Mount drill in drill chuck and set speed.
3. Align workpiece with tool and clamp workpiece to table.
4. Select feed rate and set.
5. Start drill and drill workpiece using lubricant.
6. Check hole location and size, accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

DRILL PRESS OPERATOR'S MANUAL

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.14 **TASK:** Taps hole with tapping attachment.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, tapping attachment, work-holding device, drills, taps, lubricant, center drill, workpiece, and blueprint,

EVALUATION: taps hole with a tapping attachment.

STANDARD: Mount workpiece securely on table, select speed settings for drills and taps, tapped hole location and size meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in work-holding device.
2. Select tap drill and tap.
3. Secure workpiece to drill press and align with center drill.
4. Set speed and feed then center drill and drill hole.
5. Mount tapping attachment to drill press and mount tap.
6. Operate tapping attachment according to Operator's Manual.
7. Tap hole to specifications, setting drill press speed and stops.
8. Allow tap to complete cut to full depth before retracting.
9. Clean tapped hole and check with gage.
10. Accept or reject work according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 163-164, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 212, 1984.

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.15 **TASK:** Laps hole to size.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, adjustable lap, abrasives, lubricant, work-holding device, micrometer, workpiece, and blueprint,

EVALUATION: laps hole to size.

STANDARD: Mount workpiece securely on drill press table, select speed setting of lap, lapped hole meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in work-holding device.
2. Measure hole and adjust lap 0.002" - 0.003" over hole size.
3. Secure lap in drill press and start drill (slow).
4. Run lap in and out of hole with light pressure.
5. Add lubricant while moving lap in and out.
6. Clean hole and measure, repeat until hole meets print specifications.
7. Accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 136-138, 1984.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 2052, 1984.

5.0 **COMPETENCY/SKILL:** Operates drill presses according to established standards.

5.16 **TASK:** Spotfaces to specified dimension.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a drill press, work-holding device, spotfacing tool, depth micrometer, workpiece, and blueprint,

EVALUATION: spotfaces to specified dimensions.

STANDARD: Mount workpiece securely on drill press, select spotfacing tool, select spotfacing speed and depth, workpiece meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece and mount in work-holding device.
2. Mount work on drill press table and align spotface tool with hole.
3. Set speed of drill according to Machinery's Handbook.
4. Set stop for depth and start drill press.
5. Spotface workpiece to dimension using lubricant.
6. Measure workpiece and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 160, 1983.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 406, 1982.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.1 **TASK:** Cleans and lubricates grinders.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a grinder, Machinery's Handbook, Operator's Manual, cleaner, cloths, brushes, and hand tools,

EVALUATION: cleans and lubricates grinders.

STANDARD: Turn off power supply to machine, machine cleaned with cloth and brushes, lubricant applied to areas needed, meets Operator's Manual specifications.

STUDENT LEARNING EXPERIENCES:

1. Locate Operator's Manual specifications.
2. Make sure main power source is turned off.
3. Remove chips with brush and wipe machine with cloth and cleaner.
4. Lubricate machine according to Operator's Manual specifications.
5. Remove grinding wheel and ring test for cracks, mount wheel if good.
6. Check wheel cover guard for cracks.
7. Inspect grinder and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

GRINDER OPERATOR'S MANUAL

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.2 **TASK:** Selects and mounts grinding wheel.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a pedestal grinder, wheel wrench, wheels, adjustable wrench, and operators manual,

EVALUATION: selects and mounts grinding wheel.

STANDARD: Select wheel, power supply turned off, wheel checked for cracks, all safety guards put in place, stand to one side of wheel when starting grinder.

STUDENT LEARNING EXPERIENCES:

1. Select wheel and check for cracks with ring test.
2. Turn off main power source.
3. Remove all shields and remove nut and washer.
4. Clean spindle and mount wheel on spindle.
5. Apply washer and nut and tighten.
6. Replace all guards and shields.
7. Rotate wheel by hand checking for clearance.
8. Turn on main power and stand to one side of the wheel, start grinder.
9. Accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 333-334. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 496. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 436. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.3 **TASK:** Inspects grinding wheel.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given an assortment of grinding wheels, and two metal rods,

EVALUATION: inspects grinding wheels.

STANDARD: Check wheels for chips, ring test wheel, and identify wheel grit.

STUDENT LEARNING EXPERIENCES:

1. Select two metal rods.
2. Mount grinding wheel on one rod and hold in the air.
3. Tap side of wheel with second rod and listen for ring.
4. If wheel has ring there are no cracks, if it does not ring; wheel has a crack so discard.
5. Check wheel for chips and damage and determine if wheel can be repaired.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 327. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 490. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.4 **TASK:** Balances grinding wheels.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a grinding wheel, balance arbor, stand, wheel collet, grinder, diamond dresser, balance weights, and wrenches,

EVALUATION: balances a grinding wheel.

STANDARD: Wheel tested for cracks (ring test), wheel trued with diamond dresser, wheel should be balanced according to specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount grinding wheel to collet (check for cracks using ring test).
2. Mount assembly on grinder and roughly true the wheel in.
3. Remove assembly and place on balance stand.
4. Allow wheel to rotate until heavy side is down and put chalk mark, then draw horizontal line through the center.
5. Mount two weights on each side of centerline.
6. Rotate wheel 90 degrees.
7. Adjust weights until wheel remains in this position.
8. Rotate wheel 180 degrees and check.
9. Accept or reject work depending on wheel movement.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 335. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 496-497. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 437. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.5 **TASK:** Dresses and trues grinding wheels on pedestal grinder.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a grinder, sharpening tools, grinding wheel, mechanical wheel dresser, wrenches, and Machinery's Handbook,

EVALUATION: dresses and trues grinding wheel on pedestal grinder.

STANDARD: Use mechanical wheel dresser, wheel ring tested, wheel mounted securely, all guards in place, work rest is located to specified distance from wheel.

STUDENT LEARNING EXPERIENCES:

1. Wheel checked for cracks (ring test).
2. Select wheel dresser and adjust work rest for lugs to ride on front of work rest.
3. Start grinder standing to one side of wheel.
4. Put dresser on work rest and apply to wheel.
5. Move dresser across the whole wheel until wheel has sharp corners.
6. Continue until wheel is dressed and trued.
7. Adjust work rest to within 1/8" or less of wheel.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 335-336. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 497-498. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.6 **TASK:** Dresses and trues machine tool grinding wheel.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a surface grinder, dressing tool, blueprint, diamond point dresser, fixed tool post, and magnetic chuck,

EVALUATION: dresses and trues machine tool grinding wheel.

STANDARD: Select and mount wheel dresser, amount the wheel is lowered for each pass and wheel dressed is according to specifications.

STUDENT LEARNING EXPERIENCES:

1. Ring test wheel for cracks.
2. Select and mount diamond point dresser to magnetic bed.
3. Position dresser to left of center line of wheel.
4. Raise wheel above diamond dresser and start grinder.
5. Lower wheel until wheel touches diamond.
6. Feed diamond across wheel with crossfeed handle.
7. Lower wheel 0.0005" for each pass until wheel is dressed to specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 335-336. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 497-498. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.7 **TASK:** Grinds and shapes chisel and hand tools on pedestal grinder.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a pedestal grinder, specifications, hand tools, drills, punches, screwdrivers, and wheel dresser,

EVALUATION: grinds and shapes chisel and hand tools on pedestal grinder.

STANDARD: Select angles used on chisels and hand tools, tools held against work rest while sharpening, tools sharpened to specifications.

STUDENT LEARNING EXPERIENCES:

1. Inspect grinding wheel and dress if needed.
2. Adjust work rest to be within 1/8" or closer.
3. Start grinder and grind tool.
4. Grind tool to correct angle checking with protractor.
5. Change angle if necessary and regrind.
6. Inspect tool and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 68. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 114-120. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.8 **TASK:** Grinds and sharpens lathe tools free hand.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a pedestal grinder, lathe tool bit, wheel dresser, tool angle gage, protractor, oilstone, Machinist's Handbook and blueprint,

EVALUATION: grinds and sharpens lathe tool free hand.

STANDARD: Angles ground (6 angles to be ground for lathe tools), angles checked with angle gage and protractor, lathe meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Check references for lathe tool angles to be needed.
2. Check tool rest and wheel face and repair if needed.
3. Grip one end of tool with both hands and rest left hand on work rest.
4. Hold tool at approximate angle for cutting edge and relief angle and grind across face of wheel.
5. Check relief angle with tool in tool holder and with tool angle gage.
6. Grind relief angle so it forms a 70 degree angle with the side cutting edge.
7. Grind end relief angle and cutting edge angle at same time.
8. Check end relief angle with angle gage and grind until angle fits gage.
9. Grind side rake angle holding tool approximate 45 degrees to axis of wheel and grind side rake.
10. Grind slight radius on point of tool and whet cutting edges on oilstone using lubricant.
11. Check angles with angle gage and protractor and accept or reject tool according to specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 177-179. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 235-236. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA pp. 217-218. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.9 **TASK:** Grinds workpiece on magnetic chuck.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a surface grinder, magnetic chuck, ferrous workpiece, micrometer, diamond point dresser, and blueprint,

EVALUATION: grinds workpiece on a magnetic chuck.

STANDARD: Select grinding wheel, grinding wheel dressed and trued, workpiece mounted on magnetic chuck and energized, workpiece meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Clean and deburr workpiece.
2. Select and mount grinding wheel.
3. Dress and true wheel.
4. Clean magnetic chuck and place workpiece on chuck.
5. Energize chuck and check rigidity of workpiece by hand.
6. Adjust table until wheel overlap the edge of workpiece by about 1/8".
7. Start grinder and lower wheel slowly until wheel touches workpiece.
8. Take light cut on first pass and lower wheel 0.0005" 0.001" for next passes until part meets print specifications.
9. Accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 336-338. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 498-500. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.10 **TASK:** Grinds workpiece square on surface grinder.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a surface grinder, 90 degree angle plate, C-clamps, diamond dresser, micrometer, solid steel square, rough workpiece, and blueprint,

EVALUATION: grinds workpiece square on surface grinder.

STANDARD: Select wheel, mount workpiece on chuck, workpiece meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Select and mount wheel on grinder.
2. Check all guards and safety shields.
3. Use diamond dresser and dress the wheel.
4. Clean chuck and mount workpiece on angle plate and clamp.
5. Lower wheel until the wheel just clears the highest point of the workpiece.
6. Start grinder and lower wheel to desired cut, cut first surface until surface is cleaned.
7. Rotate workpiece 90 degrees on angle plate and repeat steps 5 and 6.
8. Rotate workpiece again until all four sides are machined.
9. Measure workpiece and accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 339-340. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg/McGraw-Hill Book Company, Novato, CA. pp. 506-507. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.11 **TASK:** Grinds workpiece lined up with indicator.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a surface grinder, work-holding device, dial indicator, surface plate, angle plate, clamps, diamond wheel dresser, workpiece, and blueprint,

EVALUATION: grinds workpiece lined up with the indicator.

STANDARD: Select wheel, mount workpiece on angle plate, use indicator to set workpiece level, part meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Check print for specifications of part to be machined.
2. Clean angle plate and surface plate.
3. Mount angle plate on surface plate and clamp workpiece to angle plate.
4. Rough align workpiece using square.
5. Align workpiece level using the dial indicator on surface gage.
6. Dress wheel and mount angle plate with workpiece on magnetic chuck.
7. Grind workpiece and measure.
8. Accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 340. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 507-508. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.12 **TASK:** Polishes with buffing wheel on grinder.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a grinder, polishing wheel, workpiece, and polishing compound,

EVALUATION: polishes with buffing wheel on grinder.

STANDARD: Mount polishing wheel, apply polishing compound, workpiece meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Select and mount polishing wheel.
2. Turn on grinder and apply compound to polishing wheel.
3. Polish workpiece applying pressure at the center of wheel or just below center.
4. Hold workpiece firmly and polish part.
5. Check polished surface and accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 166-167. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 213-214. 1984.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY. pp. 2059-2060. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.13 **TASK:** Grinds angular surfaces.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a surface grinder, angle plate, clamps, gage blocks, granite surface plate, indicator with base, calipers, workpiece, and blueprint,

EVALUATION: grinds angular surfaces.

STANDARD: Mount and dress grinding wheel, calculations used to find angle for stacking gage blocks, use of sine bar, mount workpiece securely to angle plate, angle meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Select and mount surface wheel.
2. Calculate the gage blocks needed to be wring by using the formula for sine bar (located in Machinist's Handbook).
3. Mount workpiece on sine bar set-up and clamp to angle plate.
4. Mount angle plate with workpiece to the magnetic plate.
5. Turn on grinder and lower wheel till wheel touches part.
6. Lower wheel 0.0005"-0.001 and grind part until angle meets print specifications.
7. Accept or reject workpiece according to blueprint.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 330. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 508. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.14 **TASK:** Grinds radii and angles on surface grinder.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a surface grinder, radius and angle dresser, gage blocks, radius gage, micrometer, workpiece, and blueprint,

EVALUATION: grinds radii and angles on surface grinder.

STANDARD: Mount workpiece securely on surface grinder, follow procedure for dressing radius on the wheel, follow procedure for dressing the angle required on the wheel, workpiece meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Clean magnetic chuck and mount radius dresser square.
2. Mount height setting bar in radius dresser and against surface of magnetic chuck.
3. Wring gage blocks for radius dimensions and place between height setting bar and diamond point.
4. Raise diamond until it holds gage block and lock.
5. Move table till diamond is located under wheel center.
6. Rotate radius dresser 1/4 turn to locate diamond horizontal.
7. Start grinder and move saddle until diamond touches side of wheel, and stop grinder.
8. Raise wheel until wheel clears diamond and start grinder.
9. Lower wheel slowly while rotating radius dresser through 90 degree arc until diamond touches wheel.
10. Lower wheel 0.002"-0.003" down for each rotation of radius dresser until radius is complete.
11. To grind angle mount angle dress square on magnetic chuck.
12. Locate diamond under wheel and lower wheel until it touches the diamond, take only 0.002"-0.003" cut.
13. Stop grinder and loosen swivel stop pins and adjust until required angle indicates on vernier plate.
14. Feed diamond across wheel with angle traverse handle.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 508-510. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 414-415. 1984.

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6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.15 **TASK:** Cuts off or parts material with grinding wheel.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a grinder magnetic chuck, diamond dresser, reinforced abrasive cut off wheel, calipers, work-holding device, workpiece, and blueprint,

EVALUATION: cuts off or parts material with grinding wheel.

STANDARD: Mount abrasive wheel, mount workpiece securely on magnetic chuck, parted workpiece meets tolerances specified by the blueprint.

STUDENT LEARNING EXPERIENCES:

1. Select cut off wheel and mount on grinder.
2. Dress wheel and check all guards making sure they are secure.
3. Mount work in work-holding device.
4. Align workpiece parallel or at right angles to the table and energize magnetic chuck.
5. Adjust workpiece until it clears center of cut off wheel about 1".
6. Place a board or masonite on magnetic chuck under part to be cut off to prevent damage to the chuck.
7. Check part for length and accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 510-511. 1984.

6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.16 **TASK:** Grinds workpiece between centers.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a cylindrical grinder. Machinery's Handbook, diamond point wheel dresser, centers, test bar, dial indicator micrometer, workpiece, and blueprint,

EVALUATION: grinds workpiece between centers.

STANDARD: Align centers with test bar, select grinding wheel speed, set automatic feed and depth of cut, finished part meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Select centers and check conditions of centers.
2. Align centers with test bar using the dial indicator.
3. Dress and true grinding wheel.
4. Place dog on workpiece and mount between centers.
5. Clamp driving dog on workpiece and adjust driveplate pin.
6. Start grinder and run, checking for speed of wheel and adjust.
7. Set headstock rotation counterclockwise.
8. Set automatic feed mechanism and select table traverse feed.
9. Start table traversing and slowly touch wheel to work.
10. Grind workpiece until surface cleans up.
11. Check part for taper and adjust if necessary.
12. Calculate amount of material to be removed and set depth.
13. Check finished part and accept or reject according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 343-344. 1983.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 514-516. 1984.

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6.0 **COMPETENCY/SKILL:** Operates grinders according to established standards.

6.17 **TASK:** Uses a pedestal grinder.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a pedestal grinder, wheel, diamond point dresser, workpiece, and blueprint,

EVALUATION: uses a pedestal grinder.

STANDARD: Mount wheel, guard securely in place, wheel dressed and trued, part meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Select grinding wheel and mount securely.
2. Tool rest positioned 1/8" or closer.
3. Grind part to blueprint specifications.
4. Accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 176-177. 1983.

7.0 **COMPETENCY/SKILL:** Operates power saws according to established standards.

7.1 **TASK:** Cleans and lubricates power saw.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a band saw, cleaner, lubricant, cloths, brush, wrenches, and Operator's Manual,

EVALUATION: cleans and lubricates the power saw.

STANDARD: Band saw cleaned and lubricated according to Operator's Manual, blade tension adjusted according to width of blade.

STUDENT LEARNING EXPERIENCES:

1. Clean off chips with brush.
2. Wipe off oil and dirt with cloth.
3. Lubricate saw according to Operator's Manual specifications.
4. Grease all fittings, fill all oil cups, apply oil to slides lightly.
5. Inspect saw for blade tension, vertical alignment of blade, damage to blade teeth, insert adjusted to tolerances.
6. Start band saw and check adjustments, accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

POWER SAW OPERATOR'S MANUAL

7.0 **COMPETENCY/SKILL:** Operates power saws according to established standards.

7.2 **TASK:** Replaces saw blade.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a saw, blade, hand tools, and Operator's Manual,

EVALUATION: replaces saw blade.

STANDARD: Select saw blade, align blade, blade tension adjusted according to width of blade, all safety guards in place and adjusted.

STUDENT LEARNING EXPERIENCES:

1. Select saw blade.
2. Cut off power at main box.
3. Release tension on old blade and remove, loop blade and put in storage.
4. Inspect guides and replace if necessary.
5. Unwind and install new blade.
6. Apply tension to blade according to Operator's Manual.
7. Check blade teeth direction and guide seating.
8. Start saw and set speed.
9. Inspect work and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 113. 1984

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 157-158. 1984

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. 1984.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY. 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA. 1982.

POWER SAW OPERATOR'S MANUAL

7.0 **COMPETENCY/SKILL:** Operates power saws according to established standards.

7.3 **TASK:** Selects and sets speed and feed for sawing operations.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a band saw, Operator's Manual, Machinist's Handbook, workpiece, and blueprint,

EVALUATION: selects and sets speed and feed for sawing operation.

STANDARD: Select speed setting, feed rate determined by amount of penetration, select blade, blade mounted and guards in place, demonstrates safety precautions while using band saw.

STUDENT LEARNING EXPERIENCES:

1. Select material to be used according to print specifications.
2. Select saw blade and mount.
3. Set speed according to Machinery's Handbook.
4. Turn on saw and feed workpiece into blade cut to print specifications.
5. Accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 131-133. 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA. pp. 374-376. 1982.

7.0 **COMPETENCY/SKILL:** Operates power saws according to established standards.

7.4 **TASK:** Cuts material to length with power hack saw.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a power hack saw, measuring tools, workpiece, and blueprint,

EVALUATION: cuts material to length with power hack saw.

STANDARD: Select blade, speed setting, blade mounted securely, workpiece marked to print specifications, workpiece cut and cleaned to meet print tolerances.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece according to print specifications.
2. Select blade and mount.
3. Measure part for length and mark with file/scribe.
4. Check vise with square.
5. Set saw speed and feed according to references.
6. Clamp work to vise and start saw.
7. Lower blade to workpiece with blade on waste side of cut, and engage feed.
8. Deburr workpiece and check measurement.
9. Accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 115. 1984.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 158. 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA. pp. 136-137. 1984.

7.0 **COMPETENCY/SKILL:** Operates power saws according to established standards.

7.5 **TASK:** Saws along a scribed line.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a band saw, blade, measuring instruments, work-holding device, workpiece, and blueprint,

EVALUATION: saws along a scribed line.

STANDARD: Select blade, set speed, blade mounted securely, part cut to print specifications.

STUDENT LEARNING EXPERIENCES:

1. Select blade, mount and align blade.
2. Scribe workpiece to print specifications.
3. Determine speed setting and secure work in work-holding device.
4. Start saw and machine part, cutting on waste side of scribed line.
5. Measure and inspect part.
6. Accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 121. 1984.

7.0 **COMPETENCY/SKILL:** Operates power saws according to established standards.

7.6 **TASK:** Cuts and welds band saw blade.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a band saw blade, tin snips, band saw butt welder, and grinder,

EVALUATION: cuts and welds band saw blade.

STANDARD: Weld blade straight, annealed, blade meets length requirements.

STUDENT LEARNING EXPERIENCES:

1. Turn off electrical power at main box.
2. Release blade tension and cut blade with tin snips.
3. Grind blade ends square and insert blade ends in welder.
4. Set pressure and weld.
5. Loosen clamps and grind weld, removing flash.
6. Clamp and anneal (dull red color).
7. Remove for welder and check blade thickness.
8. Mount blade and adjust tension.
9. Test run blade and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 122. 1984.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 168-169. 1984.

7.0 COMPETENCY/SKILL: Operates power saws according to established standards.

7.7 TASK: Saws internal contours with band saw.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a band saw, blade butt welder, band saw blade, drill press, drills, tin snips or blade cutter, workpiece and blueprint,

EVALUATION: saws internal contours with band saw.

STANDARD: Select blade, set speed, blade welded straight and annealed, workpiece cut within print specifications.

STUDENT LEARNING EXPERIENCES:

1. Check workpiece for sharpness of internal curves.
2. Select blade according to minimum radius limit.
3. Center punch workpiece and drill hole for saw blade.
4. Remove blade and cut, insert blade through drilled hole.
5. Weld band saw blade and mount on band saw, adjust tension.
6. Saw workpiece internally, staying within 1/32" from layout line.
7. Turn off saw and remove blade and workpiece.
8. Cut blade at welded area and remove workpiece.
9. Reweld blade and mount on band saw, adjust tension.
10. Inspect workpiece and accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S. F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 122. 1984.

Krar, S. F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA. pp. 169. 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.1 **TASK:** Cleans and lubricates lathes.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, Operators Manual, cleaner, lubricants, cloths and brushes,

EVALUATION: cleans and lubricates the lathe.

STANDARD: Examine safety precautions, check all fluid levels and fill, remove all thick gum and grease, clean chips off with brush and a thin film of oil on machine surfaces.

STUDENT LEARNING EXPERIENCES:

1. Shut off power to lathe.
2. Clean off chips with brush.
3. Remove thick gum and grease with special solvent.
4. Clean lathe with cleaning fluid.
5. Lubricate lathe (check manual for lubricants)
   a. Check oil levels
   b. Add oil up to index lines
   c. Fill all small oil holes and cups
   d. Wipe machined surfaces with thin oil film
6. Clean coolant system if necessary.
7. Test run lathe for final check.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES

Krar, S.F. TURNING TECHNOLOGY: (ENGINE AND TURRET LATHES). (classic text). Delmar Publishers, Albany, NY., pp. 22-27, 1971.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.2 **TASK** Faces workpiece.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a piece of round stock, and a preground lathe tool bit,

EVALUATION: faces workpiece off to within a tolerance.

STANDARD: Tolerances, to be held on length, face square to the axis of the work, and surface finish.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in chuck and check for running true.
2. Mount facing tool in tool holder.
3. Adjust angle of tool holder and tool.
4. Center tool to center of workpiece (vertically).
5. Lock carriage to the bed.
6. Select and set speed and feed.
7. Check to insure ends are square to the axis of the work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 189-190, 1983.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.3 **TASK:** Sets lathe speed and rough cuts workpiece.

PERFORMANCE OBJECTIVE:

CONDITIONS Given a lathe, work-holding device, cutting tool, micrometer, Machinery's Handbook, workpiece, and blueprint,

EVALUATION: sets the lathe speed and rough cut workpiece.

STANDARD: Part meets blueprint specifications and is within tolerences specified, lathe speed setting and selection of feed, and safety precaution observed while operating lathe.

STUDENT LEARNING EXPERIENCES:

1. Calculate speed of lathe using formula:
   $$\text{rpm} = \frac{\text{cutting speed} \times 4}{\text{work piece diameter}}$$
2. Select feed of lathe.
3. Check blueprint for required dimensions.
4. Mount workpiece and cutting tool.
5. Rough cut workpiece to specific size.
6. Measure workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 253, 1984.

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 200-201, 1983.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.4 **TASK:** Sets lathe speed and finish cuts workpiece.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, work-holding device, cutting tool, micrometer, Machinery's Handbook, workpiece and blueprint,

EVALUATION: sets the lathe speed and finish cut workpiece.

STANDARD: Part meets blueprint specifications and within tolerences specified, lathe speed setting, selection of feed, and safety precautions observed while operating lathe.

STUDENT LEARNING EXPERIENCES:

1. Calculate speed of lathe using formula:
   rpm = cutting speed x 4

   ---

   workpiece diameter

2. Select feed of lathe.

3. Check blueprints for finished dimensions and surface finishes.

4. Mount workpiece and cutting tool.

5. Finish cut workpiece to specific size.

6. Measure workpiece and either accept or reject workpiece determined by dimension tolerences.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 201, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 253, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.5 **TASK:** Drills holes with lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, cutting tools, center drill, drills, lubricant drill chuck and key, micrometer, and blueprint,

EVALUATION: drills holes with lathe.

STANDARD: Select speed, select drills, use proper sequence of tools, drill holes to specification, and accept or reject workpiece.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in lathe.
2. Select and set speeds for drills.
3. Face and center drill workpiece.
4. Select correct sequence of drills.
5. Drill workpiece to specifications.
6. Measure drilled holes.
7. Accept or reject workpiece according to tolerences.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 246-247, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 303-304, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathe according to established standards.

8.6 **TASK:** Reams holes with lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, drills, reamers, micrometer, Machinery's Handboook, drill chuck and key, lubricant, and blueprint,

EVALUATION: reams hole with lathe.

STANDARD: Correctly select drill and reamer, set lathe speed for drill, correct speed for reamer, correct feed of reamer, ream hole to specification, workpiece accepted or rejected according to tolerances.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece material and hole diameter.
2. Set lathe speed for drilling.
3. Mount drill chuck and center drill in tailstock.
4. Start lathe and center drill and drill hole undersize.
5. Select reamer and set speed 1/2 drill speed.
6. Mount reamer in tailstock and feed at moderate speed.
7. Measure hole with plug gage and approve or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 305, 1984.

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 249-252, 1983.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.7 **TASK:** Bores holes with lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS Given a lathe, lathe chuck, boring bar, drills, Machinery's Handbook, micrometer, blueprint, and telescoping gage,

EVALUATION: bores a hole with the lathe.

STANDARD: Select lathe speed for drilling, correct sequence of step drilling, select boring bar and mount boring bar with tool on center height, measure hole within blueprint tolerences.

STUDENT LEARNING EXPERIENCES:

1. Mount work in lathe and select correct lathe speed.
2. Center drill then drill workpiece to within 1/8" of blueprint specification.
3. Select boring bar and check for sharpness and clearance.
4. Mount boring bar with tool on center height.
5. Move cross feed handle in reverse to enlarge hole.
6. Take light cuts to meet print specification.
7. Measure bored hole and accept or reject part.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 247-248, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 304-305, 1984.

Repp, Victor. E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 247-249, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.8 **TASK:** Counterbores holes using lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, drills, boring bar, drill chuck depth micrometer, left hand boring tool, and blueprint,

EVALUATION: counterbores hole using lathe.

STANDARD: Select speed for drills, select boring bar, correct centering of left hand boring tool, correct depth and diameter of counterbore tolerences as determined by the blueprints.

STUDENT LEARNING EXPERIENCES:

1. Select correct boring bar (largest bar possible).
2. Adjust boring bar and carriage stop.
3. Make rough cuts and check diameter.
4. Make finish cuts to specified dimensions.
5. Measure depth and diameters of counterbore and either accept or reject part according to blueprint tolerences.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. TURNING TECHNOLOGY: ENGINE & TURRET LATHES. Delmar Publishers, Albany, NY., pp. 194, 1971, (Classic Text).

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.9 **TASK:** Countersinks holes using lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe and chuck, combination drill and countersink, drills, drill chuck and key, countersink tool bit, workpiece and blueprint,

EVALUATION: countersinks holes using both methods.

STANDARD: Countersink method #1 Select countersink cutter to blueprint specification, depth of countersink, select lathe speed.
Countersink method #2 Select lathe speed, angle of compound rest, correct mounting of tool bit and holder, and correct angle of countersink and depth.

STUDENT LEARNING EXPERIENCES:

Method #1

1. Chuck workpiece in lathe.
2. Select and set lathe speed.
3. Center drill and drill workpiece.
4. Countersink to blueprint specification using lubricant, reduced lathe speed, checking measurements during operation.

Method #2

1. Chuck workpiece in lathe.
2. Select and set lathe speed.
3. Center drill and drill.
4. Set compound rest angle.
5. Mount cutter on center in toolholder.
6. Feed cutter bit with compound rest.
7. Check angle and countersink to blueprint specification, using lubricant, and reduced speed.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 165, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 210, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.10 **TASK:** Aligns lathes centers using accurate measurement techniques.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, test bar, centers, dial indicators, and wrenches,

EVALUATION: aligns lathe centers using accurate measurement techniques.

STANDARD: Mount centers, use correct way to rough align, correct mounting of test bar, adjust tailstock to tolerance required.

STUDENT LEARNING EXPERIENCES:

1. Clean centers and spindle holes before mounting centers.
2. Check alignment of center in headstock.
3. Check index marks on tailstock and bring centers together for rough alignment check.
4. Mount indicator on tool post.
5. Set indicator dial at zero and check test bar.
6. Adjust tailstock to tolerance required.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 192-195, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 245-246, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.11 **TASK:** Turns workpiece between centers on a lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, lathe centers, center drills, lathe dog, drive plate, machinist's handbook, workpiece, and blueprint,

EVALUATION: turns workpiece between centers.

STANDARD: Mount drive plate and centers, center alignment, use proper lathe dog set up, correct speed of lathe, correct feed, mount tool and holder, and correct finish and tolerances.

STUDENT LEARNING EXPERIENCES:

1. Mount drive plate, centers, lathe dog.
2. Correct alignment of centers.
3. Correct setting of speed and feed for rough and finish cuts.
4. Accept or reject workpiece according to blueprint specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 200-201, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 252, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.12 **TASK:** Knurls parts with lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, toolholder, workpiece, knurling tool, cutting oil, brush, and blueprint,

EVALUATION: knurls parts on lathe.

STANDARD: Set lathe feed and speed, correct knurling tool selection determined by blueprint, appearance of pattern of knurl depth, observe and demonstrate all safety rules.

STUDENT LEARNING EXPERIENCES:

1. Mount and lay off length of knurled area.

2. Calculate work diameter to be knurled
   a. Number of serrations= (21 x) (D- 0.017)
      (D= finish diameter) (π = 3.14)

   b. O.D. = (number of serrations) x (0.015)
      (O.D. = turned diameter to be knurled)

3. Correct selection of feed and speed. Approx 1/2 turning speed.

4. Position and alignment of knurling tool.

5. Start lathe and feed knurl into workpiece checking pattern and make adjustments as required.

6. Knurl workpiece to print specification and either accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 207-208, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 258-259, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.13 **TASK:** Taps holes with lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, center drill, tap, drill, drill chuck, workpiece, and blueprint,

EVALUATION: taps hole with the lathe.

STANDARD: Mount workpiece, select drills and tap, and correct check of threads with GO-NO GO gages.

STUDENT LEARNING EXPERIENCES:

1. Face and center drilling workpiece.
2. Drill hole with tap drill.
3. Chamfer hole.
4. Start tap in hole with tailstock center against end of tap and apply pressure.
5. Apply lubricant and back tap out occasionally to break chips and clean out chips.
6. Tap hole with the three different taps, taper, plug, and bottom.
7. Measure hole with GO and NO-GO gages and either accept or reject workpiece according to specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 230, 1983.

Oberg, Erik MACHINERY'S HANDBOODK. 22nd Edition Industrial Press, New York, NY., pp. 1694, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.14 **TASK:** Aligns workpiece in four jaw chuck.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, workpiece four jaw independent chuck, dial indiactor, and chalk,

EVALUATION: aligns workpiece in the four jaw chuck.

STANDARD: Mount workpiece using rings on chuck face for rough alignment, set up dial indicator, and workpiece is within blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in chuck using the rings on chuck face for rough alignment.

2. Center workpiece with chalk using two opposite jaws for each adjustment
   a. Mount toolholder in toolpost
   b. Rest chalk on toolholder
   c. Rotate workpiece holding chalk against workpiece

3. Mount indicator on toolpost.

4. Check one pair of opposite jaws with indicator against workpiece and adjust one-half of error.

5. Check other opposite jaws and adjust one-half error.

6. Repeat until workpiece is within tolerance and all jaws are tightened.

7. Accept or reject workpiece according to blueprint specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 238-239, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 298-300, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.15 **TASK:** Cuts external tapers with compound rest.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, lathe tool bits, lay out dye, steel rule, micrometer, and blueprint,

EVALUATION: cuts an external taper using the compound rest.

STANDARD: Face and center drill, mount workpiece in chuck, set compound rest at angle, make rough cut, and finish cut to specification.

STUDENT LEARNING EXPERIENCES:

1. Chuck workpiece in chuck.
2. Select speed for rough cut and finish cuts.
3. Set compound rest to angle specified by blueprint.
4. Set up tooling for cutting.
5. Make rough cuts and make adjustments.
6. Measure workpiece and adjust to blueprint specification.
7. Make finish cut and measure.
8. Accept or reject workpiece due to blueprint.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 214-215, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 270, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.16 **TASK:** Cuts tapers by offsetting the tailstock.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe and lathe tools, micrometer, steel rule, dial indicator and base, lathe dog, drive plate and blueprint,

EVALUATION: cuts taper by offsetting the tailstock.

STANDARD: Set up workpiece between centers, set tailstock to angle needed for taper, and set speed for rough and finish cuts.

STUDENT LEARNING EXPERIENCES:

1. Mount dial indicator on compound rest and check centerline of tailstock spindle.

2. Set dial indicator at zero.

3. Calculate tailstock set over using formula:

$$\text{Offset} = \frac{L \times (D-d)}{2 \times l}$$

D= diameter at large end of taper
d= diameter at small end of taper
L= total length of workpiece
l= length of taper

4. Place workpiece between centers.

5. Check lathe dog for clearance, and lubricate tailstock center if necessary.

6. Set lathe speed and feed.

7. Mark off taper length and rough cut stock.

8. Make adjustments and do finish cut.

9. Check taper and accept or reject according to blueprint specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 214, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 267-268, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.17 **TASK:** Cuts a long external tapered surface with taper attachment.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe and cutting tools, taper attachment, drill chuck and key, center drill, micrometer, workpiece and blueprint,

EVALUATION: cuts a long external tapered surface with a taper attachment.

STANDARD: Mount work in lathe, face and center drill workpiece, set speed, set up taper attachment, workpiece taper length and diameters must meet blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Chuck workpiece in lathe.
2. Select and set speed.
3. Face and center drill workpiece.
4. Set taper attachment for required taper.
5. Make rough cut.
6. Measure workpiece and make required adjustments.
7. Finish cut to specification.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 211-212, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 268, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.18 **TASK** Cuts internal tapered surfaces with taper attachment.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, chuck, drill chuck and key, drills, center drills, boring bar with tool insert,

EVALUATION: cuts internal tapered surfaces with taper attachment.

STANDARD: Calculate taper for taper attachment, true workpiece, select speed, set up boring bar and taper attachment, accuracy of taper must be to print specification.

STUDENT LEARNING EXPERIENCES:

1. Calculate taper.
2. Chuck workpiece, and true workpiece with dial indicator.
3. Select and set speed.
4. Step drill to blueprint specifications.
5. Mount boring bar on compound rest.
6. Adjust taper attachment.
7. Set boring bar to print specification and set center height.
8. Turn taper and check.
9. Finish cut and check for print specification.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 212-216, 1983.

Repp, Victor, E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 252-255, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.19 **TASK:** Die cuts threads with lathe, hand threading.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, lathe chuck and tools, die, diestock, thread ring gage, cutting oil, and blueprint,

EVALUATION: die cuts threads with lathe by hand threading.

STANDARD: Mount workpiece in lathe chuck, select die and diestock, cut threads, and check threads with thread ring gage.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in lathe. Stock should be 0.002" to 0.005" undersize, and end chamfered, approximately 45 degrees.
2. Mark off length of thread to be cut.
3. Mount diestock assembly on workpiece and start threading.
4. Cut threads on stock using cutting oil.
5. Check thread with ring gage and accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Repp, Victor. E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 119-120, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.20 **TASK:** Die cuts threads with lathe using die heads.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, lathe chuck, die head, lathe tools, ring gage, workpiece, and blueprint,

EVALUATION: die cuts threads with lathe using die heads.

STANDARD: Workpiece secured in chuck and end chamfered, thread to length according to prints, and workpiece checked with GO and NO-GO gage.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in lathe chuck and chamfer end.
2. Select die head and chasers and mount chasers on die head.
3. Set machine speed and set stops.
4. Close chasers with die head handle and start lathe.
5. Engage die head and thread workpiece.
6. adjustments.
7. Check workpiece with GO and NO-GO gage and either accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 119-120, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.21 **TASK:** Turns or threads long workpiece using follower and steady rest.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, lathe tools, universal lathe chuck, steady rest, follower rest, micrometer, lathe center, workpiece and blueprint,

EVALUATION: turns or threads long workpiece using follower rest and steady rest.

STANDARD: Mount workpiece, face and center drill, steady rest bolted to lathe bed, adjust jaws to touch workpiece, finished workpiece must meet blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in chuck, face and center drill.
2. Mount steady rest on lathe and adjust the jaws.
3. Lubricate jaws and check jaw locks for tightness.
4. Mount tool and tool holder on lathe.
5. Turn workpiece to designated dimension.
6. Check steady rest and carriage clearance.
7. Accept or reject workpiece according to print specification.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 232-234, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 290-292, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 234-235, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.22 **TASK:** Machines part with carbide tool.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, carbide tool holder, carbide insert, micrometer, workpiece, and blueprint,

EVALUATION: machines part with carbide tool.

STANDARD: Mount workpiece securly in chuck, select tool and tool holder, adjust lathe speed and feed according to Machinery's Handbook, mount tool holder, select carbide insert, part should be machined to print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in chuck.
2. Select carbide tool and toolholder
   a. select grade
   b. select shape
   c. select size
3. Set lathe speed and feed.
4. Mount carbide tool and toolholder on lathe.
5. Machine workpiece to print specification and accept or reject part.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 540-543, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.23 **TASK:** Swings convex or concave radii from compound swivel.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, work-holding device, radius gage, grinder, workpiece, and blueprint,

EVALUATION: swings convex or concave radius using compound rest.

STANDARD: Locate and size radius, mount tool and toolholder on compound rest, check radius with radius gage, part meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in lathe and set lathe speed.
2. Check print for size and location of radius.
3. Layout radius location on workpiece.
4. Mount tool and toolholder on compound rest.
5. Locate radius and lock carriage, loosen bolts on compound rest to allow rest to swivel.
6. Start lathe and advance cross feed to touch workpiece.
7. Swing compound rest in direction of cut.
8. Advance tool approximately 0.020" and take cut.
9. Check radius with radius gage and adjust tool if necessary.
10. Continue cuts until radius is complete.
11. Check radius with gage and accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 218-219, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 260, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.24 **TASK:** Chases single point external threads with lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe chuck, threading tool, GO and NO-GO gage, workpiece and blueprint,

EVALUATION: chases a single point external thread using the lathe.

STANDARD: Select lathe speed and thread dial selection according to print specifications, angle of compound rest (29 degrees), check finish part with GO and NO-GO gage.

STUDENT LEARNING EXPERIENCES:

1. Chuck workpiece in lathe and face and center drill end.
2. Select and set speed.
3. Set compound rest at 29 degrees angle.
4. Mount cutter bit, and set gear box and headstock gears.
5. Set lathe speed, and start lathe.
6. Make thread dial selection.
7. Cut threads to depth and check fit with GO and NO-GO gages.
8. Accept or reject workpiece according to print specification.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 221-226, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 279-281, 1984.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition Industrial Press, New York, NY., pp. 1424-1430, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 255-257, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.25 **TASK:** Chases single point internal threads with the lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, drill chuck, drills, boring bar single point threading tool, GO and NO-GO gages workpiece and blueprint,

EVALUATION: chases a single point internal thread with the lathe.

STANDARD: Mount workpiece in chuck, inside diameter hole meets print specifications, select thread dial, compound rest setting, checking thread with GO and NO-GO gages.

STUDENT LEARNING EXPERIENCES:

1. Chuck workpiece in lathe, face and center drill end.
2. Select and set speed.
3. Step drill workpiece and bore to specification.
4. Compound rest set at correct angle (29 degrees).
5. Make thread dial selection.
6. Cut threads, check fit of GO and NO-GO gages.
7. Accept or reject part according to print specification.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 230-231, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 257-258, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.26 **TASK:** Rechases threads on lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, work-holding device, threading took GO and NO-GO gages, threaded workpiece, and blueprint,

EVALUATION: rechases threads on lathe.

STANDARD: Align threading tool to threads on workpiece, compound rest set at angle, set gear box, rechased threads must meet GO and NO-GO gage specification.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in lathe.
2. Mount and align threading tool.
3. Set compound rest at 29 degrees.
4. Set lathe gear box and gears on headstock.
5. Set lathe speed and start.
6. Adjust cross feed and compound rest until tool matches thread.
7. Take cuts until threads are at the designated dimension.
8. Check thread with GO and NO-GO gage and accept or reject part.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 227, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company Novato, CA., pp. 281-281, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 258, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.27 **TASK:** Chases metric threads.

PERFORMACE OBJECTIVE:

CONDITIONS: Given a lathe, threading tool, metric thread ring gage, workpiece, and blueprint,

EVALUATION: chases metric threads.

STANDARD: Mount workpiece and threading tool to be aligned with center gage, set gear box and gears on headstock, check threads with metric thread gage. Accept or reject workpiece according to print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in lathe, and select lathe speed.
2. Mount and align threading tool, and set compound rest.
3. Set gear box and gears on headstock.
4. Take trial cut and adjust if necessary.
5. Cut threads to required depth.
6. Check thread with metric thread ring gage.
7. Accept or reject workpiece according to print specification.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL TECHNOLOGY. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 226-227, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 282, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.28 **TASK:** Performs lathe filing.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, work holding device, files, file card, micrometer, workpiece, and blueprint,

EVALUATION: performs lathe filing.

STANDARD: Selection of lathe speed should be twice the speed of turning, angle of the file is held, lathe care should be taken prior to filing, and safety precautions taken before filing. Accept or reject workpiece according to print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in lathe and set speed.
2. Disengage feed rod and lead screw.
3. File workpiece
   a. Use handle on file
   b. Ride file on workpiece continuously
   c. Avoid filing near lathe chuck
   d. Place cloth on ways to collect small particles
4. Check diameter of workpiece.
5. Accept or reject workpiece according to print specification.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 204-206, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 253-254, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 243, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.29 **TASK:** Polishes workpiece on lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, work-holding device, abrasive cloth, micrometer, workpiece filed to within 0.002" to 0.003 of finished diameter, and blueprint,

EVALUATION: polishes workpiece on lathe.

STANDARD: Mount workpiece in lathe, select lathe speed twice normal turning speed with abrasive cloth wrapped around file end. Polish workpiece until workpiece is within specified tolerances.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in lathe.
2. Set lathe speed twice the speed for normal turning.
3. Disengage feed rod and lead screw.
4. Place cloth on lathe bed to catch filings.
5. Polish workpiece until workpiece is within specified tolerances.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 206, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 254, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 243, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.30 **TASK:** Cuts acme threads.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, lathe threading tool, acme tool gage, thread ring gage, micrometer, workpiece, and blueprint,

EVALUATION: cuts acme threads.

STANDARD: Mount stock in lathe, select lathe speed, compound rest angle set at 14 1/2 degrees, align threading tool with thread gage.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in lathe.
2. Check print for thread specification.
3. Machine outside diameter to required size.
4. Mount and align threading tool with thread gage.
5. Set gears on headstock and gear box for threading.
6. Check machinist's handbook for thread depth using formula: $TD = \frac{\text{pitch} + 0.010"}{2}$
7. Cut threads to specification and either accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 228, 1983.

Krar. S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 287-288, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.31 **TASK:** Cuts multiple threads.

PERFORMANCE OBJECTIVE:

CONDITION: centers, lathe dog, micrometer, workpiece, and blueprint,

EVALUATION: cuts multiple threads.

STANDARD: Mount workpiece securly in lathe, set gear box, compound rest set at 29 degrees, use compound rest for cutting threads, workpiece should revolve 1/2 turn, workpiece meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece between centers and adjust lathe speed.
2. Set gear box for lead of thread (if lead is 1/4 set on 4).
3. Mount threading tool, and set compound rest at 29 degrees angle.
4. Calculate thread depth, and cut threads to depth using the compound rest.
5. Revolve workpiece 1/2 turn in drive plate
   a. Disengage intermediate gear of end gear train and rotate spindle the desired amount
   b. Use thread chasing dial for double start threads with odd numbered lead
6. Cut threads to depth on revolved workpiece.
7. Measure workpiece and accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, MCGraw-Hill Book Company, Novato, CA., pp. 284-285, 1984.

8.0 COMPETENCY/SKILL: Operates lathes according to established standards.

8.32 TASK: Aligns workpiece on face plate.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe dial indicator, face plate, workpiece, clamps, bolts, and soft face hammer,

EVALUATION: aligns workpiece on face plate.

STANDARD: Mount workpiece on face plate using clamps or bolts, align workpiece with the dial indicator.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece on face plate using straps or bolts.
2. Roughly line up workpiece and tighten clamps lightly.
3. Mount indicator and adjust workpiece to required accuracy.
4. Tighten workpiece securely when aligned within tolerance.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 192-195, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 224-246, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 226-227, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.33 **TASK:** Makes contour cuts with lathe.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, work-holding device, lathe tools, radius gage, micrometer, grinder, workpiece, and blueprint,

EVALUATION: makes contour cut with lathe.

STANDARD: Mount workpiece, select lathe tools, radius gage selection, align radius tool, and radius should meet blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece securely in lathe.
2. Select tool and grind tool to fit radius gage.
3. Lay out workpiece and remove excess material with lathe tool.
4. Mount radius tool and select speed.
5. Align tool with workpiece.
6. Machine workpiece and measure.
7. Make adjustments and recut.
8. Check workpiece with radius gage amd either accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 218-219, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 260-261, 1984.

8.0 **COMPETENCY/SKILL:** Operates lathes according to established standards.

8.34 **TASK:** Cuts off workpiece with a parting tool.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a lathe, work holding device, parting tool, micrometer, workpiece, and blueprint,

EVALUATION: cuts off workpiece with a parting tool.

STANDARD: Workpiece should be securely held in chuck, blade extended no more than necessary, blade on center, blade has correct back rake, feed of cutting tool, cutting fluid used, safety precautions taken, and part meets prints specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount work in chuck with as little material as possible protruding beyond the chuck
2. Mount toolholder and tool on compound rest
3. Extend parting tool only 1/8" over 1/2 the diameter
4. Set cutting tool on center and 90 degrees with the work
5. Set lathe speed to 1/2 the speed for turning
6. Start lathe and feed the crossfeed handle steadily into work
7. Correct safety precautions to be taken before starting this operation

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 244-245, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 301-302, 1984.

9.0 COMPETENCY/SKILL: Operates milling machines according to established standards.

9.1 **TASK:** Cleans, lubricates and adjusts milling machine.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a milling machine, cloths, cleaners, lubricants, wrenches, screw drivers, and Operator's Manual,

EVALUATION: cleans, lubricate and adjust milling machine.

STANDARD: Milling machine must be cleaned, lubricated and adjusted to specifications of Operator's Manual.

STUDENT LEARNING EXPERIENCES:

1. Start milling machine and check flow gages.
2. Turn off milling machine and disconnect main power.
3. Clean coolant reservoir and wipe down mill with a cloth.
4. Lubricate mill and avoid over oiling, wipe off excess.
5. Check oil levels on sight gages and fill if needed.
6. Clean and oil all sliding parts.
7. Check motor lubrication.
8. Check table movement by hand and adjust gibs if needed.
9. Check condition of mill and report any needed repairs.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Equipment Manual/Operators Manual (for specific milling machine).

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.2 **TASK:** Aligns mill head to table.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, dial indicator and holder, and wrenches,

EVALUATION: aligns mill head to table.

STANDARD: Aligns mill head in relation to table using the dial indicator and holder, to be aligned within tolerance.

STUDENT LEARNING EXPERIENCES:

1. Clean table with cloth and mount indicator holder to spindle.
2. Position indicator tip over front of table.
3. Lower spindle until indicator button touches table.
4. Set indicator on zero and rotate 180 degrees by hand.
5. Compare front and back readings and adjust head one-half reading difference.
6. Recheck setting and make adjustments.
7. Rotate spindle 90 degrees and repeat steps 3-6.
8. Check readings in both directions.
9. Adjust and check until table is aligned with spindle to required tolerance.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 290, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 400-402, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.3 **TASK:** Squares workpiece using table vise.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, table vise, mill cutter, micrometer, workpiece, square, and blueprint,

EVALUATION: squareS workpiece using the table vise.

STANDARD: Mount workpiece, set feed and speed setting, use cutting fluid, workpiece to be squared to print specifications.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece and mount securely in vise.
2. Select cutter and set up feed and speed.
3. Make first cut.
4. Rotate workpiece to place finished side against fixed jaw of vise and secure.
5. Make second cut to depth allowing material for opposite side.
6. Continue until all sides have been machined to specification.
7. Check part with square and accept or reject part.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 297-299, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 403-404, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.4 **TASK:** Aligns milling machine attachments.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, dial indicator, mill wrench, 90 degrees milling attachment, draw bar, plastic mallet, and hex wrench,

EVALUATION: aligns milling machine attachments.

STANDARD: Select draw bar for 90 degrees mill attachment, align head with dial indicator, 90 degrees attachment clamped in the correct position, and clean machine of dirt and metal shavings.

STUDENT LEARNING EXPERIENCES:

1. Replace draw bar with extended draw bar and drop quill approximately 3 inches and lock.
2. Insert 90 degrees attachment and position indicating surface parallel with table movement.
3. Snug housing clamp bolts.
4. Set up magnetic base with dial indicator and indicate the 90 degrees milling attachment for parallel alignment with table movement.
5. Secure housing clamp bolts and check for accuracy.
6. Recheck until alignment is within tolerance.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 258, 1983.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 291, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machine according to established standards.

9.5 **TASK:** Aligns milling machine fixtures with indicator.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a vise, clamping bolts, wrench, dial indicator, mallet, and indicator holder,

EVALUATION: aligns milling machine fixtures with indicator.

STANDARD: Set up indicator holder and indicator, indicate fixed jaw, vise is indicated within tolerance.

STUDENT LEARNING EXPERIENCES:

1. Clean table and mount vise.
2. Fasten vise to bed with clamping bolts (do not tighten).
3. Mount indicator on mill and place indicator point touching the fixed jaw.
4. Check vise at each end and tap vise one-half difference of reading for correction.
5. Repear steps 3 and 4 until vise is aligned within tolerance.
6. Secure clamp bolts and recheck vise for movement.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL TECHNOLOGY. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 291-292, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 402-403, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.6 **TASK:** Aligns machine workpiece mounted on machine table.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, clamps, bolts, dial indicator and holder, blocks, parallels, workpiece and blueprint,

EVALUATION: aligns machine workpiece mounted on machine table.

STANDARD: Clean the mill table and make dirt free, select clamps and bolts, align proceedures with dial indicator, workpiece should be indicated within tolerances given.

STUDENT LEARNING EXPERIENCES:

1. Clean mill table and select clamps, bolts and blocks.
2. Study print and place workpiece on machine table.
3. Center workpiece longitudinally on table and clamp down lightly.
4. Clamp indicator on spindle and touch point to workpiece edge.
5. Move table longitudinally along edge and observe total movement of indicator.
6. Adjust workpiece one-half the difference of readings by tapping lightly with soft hammer.
7. Check workpiece and adjust if necessary until workpiece is within designated tolerance.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 423-424, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.7 **TASK:** Mills workpiece with end mill.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, work-holding device, end mill cutter, micrometer, depth micrometer, workpiece, and blueprint,

EVALUATION: mills workpiece with end mill.

STANDARD: Mount workpiece on mill table, workpiece indicated is parallel to table, select speed and feed, select end mill cutter, safety precautions taken during set-up and cutting, part should be within tolerance.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece on table and indicate with dial indicator.
2. Select cutter and calculate speed and feed according to the Machinery's Handbook.
3. Start mill and touch workpiece edge and set depth of cut.
4. Lock table and machine workpiece.
5. Check workpiece and repeat cuts until machined to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 295-297, 1983.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.8 **TASK:** Locates work with center finder.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, work-holding device, centerfinder, dial indicator and holder, workpiece, and blueprint,

EVALUATION: locates work with center finder.

STANDARD: Mount workpiece and align, mount centerfinder in mill, centerfinder to be located within tolerances specified by blueprint.

STUDENT LEARNING EXPERIENCES:

1. Mount work-holding device on mill table, use dial indicator to indicate workpiece.

2. Place centerfinder in spindle and align centerfinder with punch mark.

3. Touch centerfinder point lightly with punch mark and rotate spindle by hand.

4. Check runout and adjust.

5. Mount dial indicator with pointer against centerfinder and align until table is within tolerance.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 425, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.9 **TASK:** Locates work with edgefinder.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, work-holding device, dial indicator, edgefinder, workpiece and blueprint,

EVALUATION: locates work with edgefinder.

STANDARD: Mount and indicate work-holding device on mill table, select edgefinder, position the edgefinder against workpiece to find true edge, workpiece to be located within blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount work-holding device on mill and use dial indicator to align workpiece.

2. Mount edgefinder in spindle of mill and move towards workpiece.

3. Turn on mill and move edgefinder towards workpiece until the edgefinder comes into contact and goes off center.

4. Set handwheel to zero and repeat again to check for handwheel setting, adjust if necessary and repeat.

5. Do two adjacent edges and set handwheels to zero.

6. Take 1/2 diameter of edge finder.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 425, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 322, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.10 **TASK:** Drills holes with milling machine.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, work-holding device, dial indicator, edgefinder, center drill, drills, drill chuck, hole gage, mocrometer, workpiece, and blueprint,

EVALUATION: drills holes using the milling machine.

STANDARD: Mount workpiece, locate holes according to blueprints, select drills and sequence used, set speed and feed for drills, finished workpiece must meet blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece and locate area to be drilled according to blueprint.
2. Mount drill chuck in mill and mount center drill.
3. Set speed and drill.
4. Drill first hole and note depth on print.
5. Drill subsequent holes if needed.
6. Check hole size, and locations.
7. Accept or reject part according to blueprint.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL TECHNOLOGY. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 302, 1983.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 322-323, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.11 **TASK:** Reams hole on mill.

PERFORMANCE OBJECTIVE:

CONDTIONS: Given a mill, work-holding device, drills, drill chuck, reamers, center drill, hole gage, micrometer, dial indicator, workpiece, and blueprint,

EVALUATION: reams hole on the mill.

STANDARD: Mount workpiece and align, locate holes to be reamed according to blueprint, set speed and feed drills and reamer, workpiece meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount and align workpiece on mill with dial indicator.
2. Mount drill chuck and center drill.
3. Calculate speed and feed for drills and drill hole.
4. Hole to be drilled undersize for reaming.
5. Mount reamer and set speed one-half drill speed.
6. Ream hole using lubricant and measure hole.
7. Accept or reject workpiece according to blueprint.

SUGGESTED INSTRUCTIONAL:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 302-303, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 420-421, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.12 **TASK:** Mills work with carbide cutters.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, work-holding device, carbide cutting tool, micrometer, dial indicator, workpiece, and blueprint,

EVALUATION: mills work with carbide cutter.

STANDARD: Mount workpiece in vise, align workpiece, speed and feed selection, workpiece meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in vise.
2. Select carbide cutter and set speed and feed.
3. Start mill and machine workpiece to blueprint specifications.
4. Measure workpiece and either accept or reject.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 332-33, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 293-294, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.13 **TASK:** Bores holes to tolerance with milling machine.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, holding fixture, edgefinder, drill chuck, drills, micrometer, inside micrometer, adjustable boring bar, workpiece, and blueprint,

EVALUATION: bores hole to tolerance with the milling machine.

STANDARD: Mount and align workpiece using dial indicator, locate hole using the edgefinder, sequence operations up to using the boring bar, boring hole must be to print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece on milling table and install edgefinder.
2. Locate hole location and center drill.
3. Select drill speeds and feeds.
4. Drill hole to allow for clearance of boring bar.
5. Mount boring bar and select speed and feed.
6. Adjust boring bar for light cut.
7. Adjust boring bar for cuts until bored to print specifications.
8. Measure bored hole and accept or reject workpiece according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 418-420, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 323, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.14 **TASK:** Mills workpiece using indexing operation.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, dividing head, mill cutter, dial indicator, micrometer, workpiece, and blueprint,

EVALUATION: mills workpiece using indexing operation.

STANDARD: Mount dividing head, align workpiece, check amount of movement while indexing, workpiece must meet blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount material in dividing head and check alignment.
2. Select and mount cutter.
3. Determine number of indexes workpieces to be rotated.
4. Set up indexing unit of dividing head.
5. Select and set speed and feed.
6. Start mill and touch workpiece and adjust for depth of cut.
7. Check print specifications and adjust depth and recut if necessary.
8. Rotate indexing unit for next side and repeat.
9. Measure part and accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 276-279, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 356-363, 1984.

Oberg, Erik MACHINERY'S HANDBOOK. 22nd Edition Industrial Press, New York, NY., pp. 1485, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 324-326, 1983.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.15 **TASK:** Mills an angular surface.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, angle plate, clamps, sine bar, gage blocks, surface plate, mill cutter, workpiece, and blueprint,

EVALUATION: mills an angular surface.

STANDARD: Formula used for setting angle, select cutter and workpiece, set speed and feed of cutter, workpiece meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount angle plate on surface plate.
2. Calculate gage block measurement for sine bar.
   a. Formula

      Dimension= length of sine bar x sine of angle
3. Select gage blocks and wring together.
4. Mount sine bar and gage blocks against angle plate.
5. Clamp workpiece on sine bar and mount to angle plate.
6. Mount angle plate to mill and select cutter for mill.
7. Mount cutter in mill and select cutting speed and feed.
8. Make cut and check workpiece, make adjustments and recut until workpiece meets print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 279 & 303-305, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 361-362, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 326, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.16 **TASK:** Machines external straight keyway with mill.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, vise, cutter, micrometer, dial indicator, key, workpiece, and blueprint,

EVALUATION: machines external straight keyway with mill.

STANDARD: Mount and align workpiece, size of keyway milled, select speed and feed of cutter, workpiece meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece in aligned vise.
2. Select cutter and mount in mill, check print for size.
3. Center cutter with workpiece and touch top of work.
4. Determine depth of cut and set cutter depth.
5. Layout length and cut.
6. Determine depth of keyway from Machinery's Handbook.
7. Machine keyway to within 0.020" of depth.
8. Stop mill and deburr workpiece.
9. Insert key and measure size of workpiece plus key.
10. Calculate final depth and make final adjustments.
11. Machine keyway and accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 320-321, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.17 **TASK:** Machines work mounted on V-blocks.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, V-blocks, step blocks, clamps, bolts, micrometer, workpiece, and blueprint,

EVALUATION: machines work mounted on V-block.

STANDARD: Mount V-blocks and workpiece, select cutter, select speed and feed setting of cutter, workpiece meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Clean mill table and V-blocks.
2. Mount V-blocks on table with groove running parallet to T-slot.
3. Clamp workpiece on V-blocks.
4. Select cutter and set speed and feed.
5. Machine workpiece to print specifications and accept or reject.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 260, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 422, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.18 **TASK:** Machines woodruff keyway.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, woodruff key cutter, woodruff key, vise, micrometer, dial indicator, workpiece, and blueprint,

EVALUATION: machines woodruff keyway.

STANDARD: Mount workpiece and align, select cutter to use, keyway meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount vise on table and align using dial indicator.
2. Mount workpiece in vise.
3. Select and mount keyseat cutter.
4. Set speed and feed.
5. Locate center of workpiece and align with keyseat cutter.
6. Start machine and bring cutter to touch workpiece.
7. Raise table to height and start cut moving vertical until cut on workpiece is width of cutter.
8. Calculate depth and set table.
9. Cut keyway and deburr workpiece.
10. Insert woodruff key and measure with micrometer.
11. Check print for specifications and either accept or reject part.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 263, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 407-408, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 321. 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.19 **TASK:** Machines work with vertical attachment.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, vertical attachment, mill cutters, work-holding device, dial indicator, micrometer, workpiece, and blueprint,

EVALUATION: machines work with the vertical attachment.

STANDARD: Mount workpiece in vise, select cutters, set speed and feed, mount vertical attachment, part meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Attach vertical attachment to mill.
2. Set attachment to angle specified by the print.
3. Mount work-holding device on table and clamp workpiece down.
4. Mount cutter in attachment and set speed and feed.
5. Set depth of cut and cut workpiece.
6. Measure cut and adjust if necessary.
7. Machine workpiece to print specifications and accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 258, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 329, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 292, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.20 **TASK:** Flycuts flat surface on mill.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, vise, fly cutter, cutting tool, dial indicator, micrometer, parallels, workpiece, and blueprint,

EVALUATION: flycuts flat surface on the mill.

STANDARD: Mount vise on table and align, workpiece is held securely, mount flycutter, select speed and feed, workpiece meets print specifications.

STUDNET LEARNING EXPERIENCES:

1. Select material.
2. Align vise on table, and workpiece clamped securely.
3. Select flycutter and set speed and feed.
4. Align cutter to workpiece, touch off, and set depth of cut.
5. Make cut and deburr.
6. Rotate workpiece 180 degrees and mount securely in vise.
7. Touch workpiece and set depth.
8. Make cut and check with micrometer for size.
9. Make finish cut and measure part, either accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 289, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 337, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 303, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.21 **TASK:** Jig bores on a milling machine.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, work-holding device, dial indicator, edgefinder, offset boring head, drill chuck, drills, boring bar, micrometer, workpiece, and blueprint,

EVALUATION: jig bores on a milling machine.

STANDARD: Mount workpiece in holding device locate area for hole to be bored, select sequence of drills used, bore hole to print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount work-holding device on table and align with dial indicator.
2. Mount workpiece and use edgefinder to locate true edges.
3. Adjust handwheels to find hole location according to print specification.
4. Mount drill chuck and drill holes to size.
5. Mount cutter in mill and bore hole to print specification.
6. Measure workpiece and accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 303, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 412-413, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.22 **TASK:** Mills cylindrical work with rotary table.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, rotary table, wiggler, step blocks, dial indicator, calipers, end mill, workpiece, and blueprint,

EVALUATION: mills cylindrical work with the rotary table.

STANDARD: Mount rotary table to mill, mount workpiece on rotary table, select speed and feed of cutter, workpiece to be milled according to blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Clamp and align rotary table on mill with dial indicator.
2. Clamp workpiece to rotary table.
3. Select cutter and set the speed and feed.
4. Adjust rotary table and make light cut.
5. Measure workpiece and adjust according to blueprint.
6. Inspect part for accuracy and accept or reject part.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 307-308, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 409-411, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.23 **TASK:** Mills an external radius with rotary table.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, rotary table, end mill, clamps, bolts, step blocks, dial indicator, workpiece, and blueprint,

EVALUATION: mills an external radius with the rotary table.

STANDARD: Mount workpiece on rotary table, select cutter selection and setting of speed and feed, workpiece meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece and mount on rotary table.
2. Select and mount cutter.
3. Set speed and feed for cutter to be used.
4. Locate outside of radius and start mill.
5. Mill primary cut outside finished dimension.
6. Make adjustments in depth and radius and recut.
7. Measure workpiece and make final adjustments if necessary and recut.
8. Check workpiece finish and measurements.
9. Accept or reject part according to blueprints.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 308-309, 1983.

Krar, S.F. TECHONOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 411, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.24 **TASK:** Cuts off work on mill.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, work-holding device, blocks, assortment of cutters, micrometer, square, dial indicator, workpiece, and blueprint,

EVALUATION: cuts off work on the mill.

STANDARD: Mount workpiece, select cutter used to do cutting, select speed and feed of cutter, part meets blueprint specifications.

STUDENT LEARNING EXPERIENCES:

1. Select, mount, and align workpiece in work-holding device.
2. Select and mount cutter (note direction of rotation).
3. Select speed and feed and set depth of cut.
4. Cut off workpiece using coolant and cutting close to work-holding device.
5. Measure workpiece and either accept or reject part.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 335-336 & 354-355, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 300-301, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.25 **TASK:** Forms mill workpiece.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, work-holding device, form milling cutter, radius gages, micrometer, dial indicator, workpiece, and blueprint,

EVALUATION: forms mill workpiece.

STANDARD: Mount workpiece in vise, select cutter, set speed and feed, align cutter to obtain desired shape, must meet print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount and align workpiece in vise.
2. Select and mount cutter.
3. Set speed and feed of cutter.
4. Touch workpiece and set depth of cut allowing for finish cut.
5. Make rough cut and measure part.
6. Make adjustments and cut to blueprint specifications.
7. Accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 262-263, 1983.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 302, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.26 **TASK:** Flycuts formed shape on mill.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, work-holding device, fly cutter adaptor, formed cutting tool, dial indicator, micrometer, workpiece, and blueprint,

EVALUATION: flycuts formed shape on the mill.

STANDARD: Workpiece mounted securely and aligned, flycutter mounted and speed and feed selected, check part with gage and must meet print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount and align workpiece in vise.
2. Select flycutter and mount.
3. Select speed and feed.
4. Align cutter to workpiece, touch part and set depth of cut.
5. Make rough cut and check with gage.
6. Make adjustments and recut to finish part.
7. Measure workpiece and either accept or reject part.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.27 **TASK:** Taps hole with mill.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, drill chuck, drills, tap, work-holding device, lubricant, workpiece, and blueprint,

EVALUATION: taps hole with the mill.

STANDARD: Workpiece must be securely mounted and aligned, drill selected, tap selected, location of hole to be tapped, workpiece meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount and align workpiece in vise.
2. Select drills and calculate speeds and feeds.
3. Drill hole in sequence (small to large).
4. Mount tap in chuck and set speed (60 - 100 rpm).
5. Lightly feed tap in hole and lubricate.
6. Feed to depth and reverse mill, pulling up lightly on spindle handwheel.
7. Check part and accept or reject.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.28 **TASK:** Sets speed and feed.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, Machinery's Handbook, end mill, drill, slitting saw, and worksheet,

EVALUATION: sets speed and feed.

STANDARD: Locate information in Machinery's Handbook for the three cutter, use formula, and mathematical calculations.

STUDENT LEARNING EXPERIENCES:

1. Locate general content of Handbook.
2. Recognize size of cutters.
3. Locate formula's for each cutter in Machinery's Handbook.
4. Set cutter speed and feed for different materials.
5. Set cutter speed and feed for different types of cutter material.
6. Check feed rates and tooth loads.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 269-273, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 338-342, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 307-313, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.29 **TASK:** Machines internal slots using slotter.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, slotting attachment, cutter, calipers, work-holding device, workpiece, and blueprint,

EVALUATION: machines internal slot using the slotter.

STANDARD: Mount workpiece and align with dial indicator, mount slotting attachment to mill head, set slotter stroke, set speed selection, part must meet print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount workpiece securely in vise.
2. Mount slotting attachment on mill and set to required angle.
3. Position slotting attachment over table and mount cutter.
4. Select and adjust stroke length.
5. Align cutter to workpiece and set speed.
6. Start slotting machine and make rough cut.
7. Measure workpiece and adjust to print specifications.
8. Deburr workpiece and accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 258, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 414-415, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.30 **TASK:** Machines work by straddle milling.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, vise, side milling cutters, parallels, square, micrometer, spacing collars, dial indicator, workpiece, and blueprint,

EVALUATION: machines work by straddle milling.

STANDARD: Vise secured on table, workpiece clamped and aligned, select cutters, set speed and feed, part meets print specifications.

STUDENT LEARNING EXPERIENCES:

1. Mount and align vise on table.
2. Secure work in vise.
3. Select and mount cutters on mill.
4. Mount collars using the required spacers and shims.
5. Select and set speed and feed.
6. Align workpiece to cutters and make rough cut.
7. Measure workpiece and make adjustments.
8. Make finish cuts and measure.
9. Accept or reject part according to print specifications.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 265, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 253-254, 1984.

9.0 **COMPETENCY/SKILL:** Operates milling machines according to established standards.

9.31 **TASK:** Mills gears to specifications.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a mill, gear blank, mandrel, gear tooth cutter, dividing head, steady rest, index plates, dog, square, centers, dial indicator, caliper, and blueprint,

EVALUATION: mills gears to specifications.

STANDARDS: Select attachments for gear cutting, select formula used for cutting gear blank, mount gear blank on mandrel, align cutter, check uniformity of teeth on gear blank, check part for accuracy, tolerances.

STUDENT LEARNING EXPERIENCES:

1. Mount dividing head and tailstock on milling machine table.
2. Calculate gear dimensions.
3. Calculate indexing movements.
4. Mount indexing plate on dividing head and set index crank and sector arms.
5. Press gear blank on mandrel.
6. Mount mandrel and dog on centers of dividing head.
7. Select and mount gear cutter.
8. Center gear blank under cutter.
9. Set speed and feed of mill.
10. Start mill and raise table to touch workpiece.
11. Calculate depth of tooth and raise table about two thirds the depth of tooth.
12. Notch all gear teeth using indexing set up.
13. Check number of notches and make corrections.
14. Adjust feed for finish cut and cut all teeth.
15. Measure gear with gear tooth vernier caliper to assure tolerances.

16. Accept or reject workpiece.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS, AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 282-285, 1983.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 369-375, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 330-346, 1984.

10.0 **COMPETENCY/SKILL:** Performs heat treatment tasks to satisfy job specifications.

10.1 **TASK:** Hardens workpiece.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a heat treat oven with accesories, quench bath, tool steel workpiece, hardness tester (rockwell), file, tong, face shield, and gloves,

EVALUATION: hardens workpiece.

STANDARD: Oven set at specified temperature, safety precautions taken when putting in and taking out work, part meets rockwell hardness specified on the print.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece material (tool steel) and machine to print specifications.
2. Set oven to hardened temperature determined by reference.
3. Set workpiece in oven and start oven, soak workpiece at required temperature until heated uniformly.
4. Prepare quench bath and take workpiece from oven with tongs.
5. Dip workpiece in bath and agitate up and down.
6. Test workpiece with file corner for hardness.
7. Temper workpiece, setting oven to temperature and placing workpiece in oven.
8. Soak in oven for one hour per inch thickness, then remove and let air cool.
9. Test hardness with hardness tester and accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 362, 1983.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 555-557, 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 316-317, 1982.

10.0 **COMPETENCY/SKILL:** Performs heat treatment tasks to satisfy job specifications.

10.2 **TASK:** Anneals workpiece.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a heat treat oven and accessories, hardened carbon steel workpiece, Machinery's Handbook, file and tongs,

EVALUATION: anneals workpiece.

STANDARD: Set oven at temperature for annealing, safety precautions taken while putting in and removing metal, workpiece annealed so a file will cut into it.

STUDENT LEARNING EXPERIENCES:

1. Place workpiece in heat treat oven with tongs.
2. Select and set oven according to handbook temperature used for annealing.
3. Start oven and heat workpiece uniformly to temperature.
4. Heat workpiece at temperature one hour per inch thickness.
5. Turn off oven and let part cool down inside.
6. Check workpiece with corner of file.
7. Accept or reject work.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Krar, S.F. MACHINE TOOL OPERATIONS. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 363, 1983.

Krar, S.F. TECHNOLGOY OF MACHINE TOOLS. 3rd Edition. Gregg Division, McGraw-Hill Book Company, Novato, CA., pp. 588, 1984.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA., pp. 554, 1984.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., pp. 318, 1982.

10.0 **COMPETENCY/SKILL:** Performs heat treatment tasks to satisfy job specifications.

10.3 **TASK:** Stresses draws workpiece.

PERFORMANCE OBJECTIVE:

CONDITIONS: Given a heat treat oven, tongs, stressed workpiece, and Machinery's Handbook,

EVALUATION: stresses draws workpiece.

STANDARD: Follow safety procedures, temperature setting, cooling procedure, workpiece stress draw to meet Machinery's Handbook.

STUDENT LEARNING EXPERIENCES:

1. Select workpiece material and check thickness.
2. Select and set oven temperature at normalizing temperature.
3. Place workpiece in oven with tongs and heat to required temperature.
4. Remove workpiece with tongs and air cool part.
5. Test part and accept or reject work according to Machinery's Handbook.

SUGGESTED INSTRUCTIONAL TECHNIQUES:

INSTRUCTIONAL EQUIPMENT, MATERIALS AND SUPPLIES:

RESOURCES:

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition. Industrial Press, New York, NY., pp. 2148-2149, 1984.

ANNOTATED BIBLIOGRAPHY

Barsamiam, Michael A. MACHINE TRADES PRINT READING. Goodheart-Willcox Company, Inc., South Holland, IL., 1986.

Designed for blueprint reading only and does not cover machining techniques, a fine book to help teach print reading.

Feirer, John L. GENERAL METALS. 5th Edition. McGraw-Hill Book Company, Novato, CA., 1981.

Beginning text in metals.

Krar, S.F. MACHINE TOOL OPERATION. Gregg Division, McGraw-Hill Book Company, Novato, CA., 1983.

Designed for the high school machine shop class, it is very informative but not too technical, print is easy to read along with main words in bold print, and main ideas in green print in the left margin area. The pictures and diagrams are easy to understand and each unit has review questions that pertain to the main idea of that unit.

Krar, S.F. TECHNOLOGY OF MACHINE TOOLS. 3rd Edition Gregg Division, McGraw-Hill Book Company, Novato, CA., 1984.

A more advanced version of the Machine Tool Operation book written by Krar. Smaller print is found and more technical information using alot of the same pictures and diagrams. Would be a good book for advanced students or college students.

Oberg, Erik. MACHINERY'S HANDBOOK. 22nd Edition Industrial Press, New York, NY., 1984.

All machine shops should have this book for reference. Small print, lot of charts and formulas. This book covers information usually not found in textbooks.

Repp, Victor E. MACHINE TOOL TECHNOLOGY. Glencoe Publishing Company, Encino, CA.

Has small print, good pictures and diagrams, review questions at the end of each unit, good book for advanced students.

Repp, Victor E. METALWORK TECHNOLOGY AND PRACTICE. Glencoe Publishing Company, Encino, CA., 1982.

Designed for the basic metals class, covers sheetmetal, Fonaday, Machining, Welding and other areas of the metal industry.

Taylor, David L. ELEMENTARY BLUEPRINT READING FOR MACHINISTS. 3rd Edition Delmar Publishing Company, Albany, NY., 1986.

Designed for Blueprint Reading only, does a good job in explaining how to understand print reading.